R & D SPECIALTIES

R & D SPECIALTIES

ROTrol II
Version D

USER'S MANUAL

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INTRODUCTION

The R & D Specialties ROTrol II is a state of the art control system for commercial and industrial reverse osmosis systems. The ROTrol II combines features that have not previously been available in one compact unit.

The ROTrol II is a microprocessor controlled system that can monitor multiple pressure sensors and/or pressure switches. A TDS/Conductivity monitor/controller with programmable setpoints is an integral part of the ROTrol II. The ROTrol II displays system status and all sensor and switch input status on an easy to read backlit display. User programmable setpoints are provided that allow fast and easy adjustment of system parameters.

Plug-in terminal strips allow easy wiring of all sensors and controls. The ROTrol II contains relays for control of an inlet valve, RO pump, aux/repressurization pump, and a membrane flush valve.

SPECIFICATIONS

POWER:
120VAC, Optional 240VAC, 24VAC, 50/60 Hz, 25 Watts

ENVIRONMENT:
-22°F (-30°C) to 140°F (60°C)
0-95% RH, noncondensing

ENCLOSURE:
12" X 10" X 6" (305mm X 254mm X 152mm) NEMA 4X
(Larger enclosures are provided when motor controls are incorporated.)

DISPLAY:
4 line X 20 character - backlit

SWITCH INPUTS:
Tank full/pump ON switch
Tank full/pump OFF switch
Tank low switch
Low feed pressure switch
High pump pressure switch
Pretreatment RO lockout switch

SENSOR INPUTS:
Permeate TDS/Conductivity - Standard: 0-250, PPM/uS
Optional: 0-50, 0-100, 0-500 or 0-1000 PPM/uS

OPTIONAL SENSORS:
Feed TDS/Conductivity - 0-250, 0-500, 0-1000, 0-2500, 0-5000 PPM/uS
Feed pressure sensor, 0-250 PSI
Pump pressure sensor, 0-500 PSI or 0-2500 PSI
Prefilter differential pressure sensor, 0-250 PSI
Membrane differential pressure sensor, 0-500 PSI

SPECIFICATIONS

Permeate flow meter
Concentrate flow meter
Recirculate flow meter
Feed pH, 0-12 pH

RELAY OUTPUTS:
Inlet control, 5A 120/240VAC SPDT
RO pump control, 20A max resistive, 1HP, 120/240VAC
Aux/RP pump control, 20A max resistive, 1HP, 120/240VAC
Flush control, 5A 120/240VAC SPDT

FRONT PANEL CONTROLS AND INDICATORS

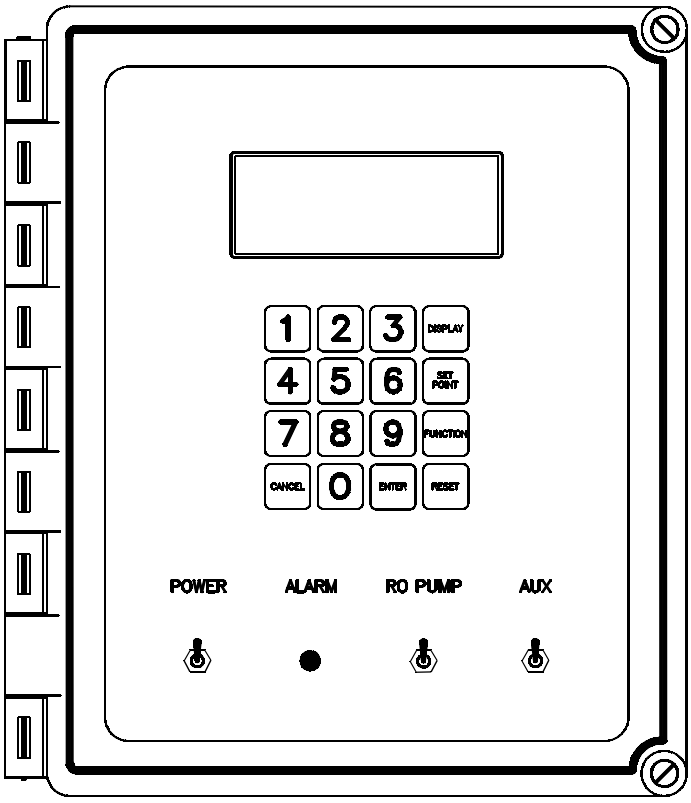


Figure 1

POWER SWITCH - Controls power to the ROTrol II electronics

ALARM LAMP - Flashes when a fault causes an RO system shutdown. On steady when a setpoint is exceeded that does not cause a RO system shutdown.

RO PUMP SWITCH - Enables or disables RO pump control.

AUX SWITCH - Enables or disables Aux/RP pump control.

DISPLAY - Shows status of ROTrol II system.

KEYBOARD - Used to input changes to the ROTrol II system.

DISPLAY KEY - Toggles display to show other status displays.

SETPOINT KEY - Allows setpoints to be displayed or changed.

FUNCTION KEY - Allows function operations to be initiated.

RESET KEY - Push once for alarm silence and twice to reset system after a shutdown has occurred.

ENTER KEY - Confirms entry of a new setpoint value or activates function.

CANCEL KEY - Aborts entry or display of a setpoint or function.

INSTALLATION

Physical Installation

Mount the ROTrol II in a convenient location on the RO equipment using either the four mounting ears provided with the unit or the optional panel mounting brackets.

Note: All terminal strips plug-in and all terminals are labeled.

Terminal Strip, Jumper and Adjustment Locations

Refer to Figure 3 for the location of all terminal strips and connectors. Figure 3 also shows all jumper and adjustment locations. Figures 4-6 show sample wiring diagrams for various power, pump and valve voltages.

Power Wiring

Refer to Figures 3-6 for terminal strip locations and wiring options. AC power for the unit is connected to terminal strip P3. The unit is configured for 120VAC operation standard. Optionally, 240VAC and 24VAC units are available. Wire the correct voltage for the unit to P3,terminals L1 and L2.

Pump and Valve Relay Outputs

The ROTrol II provides a contact closure to control the pumps and valves that are controlled by the unit. These contact closures DO NOT supply power on their own. The power to operate the pump or pump contactor and the power for the valves must be supplied to the relays. This configuration allows the pumps and valves to be operated with different voltages if required. One wire of the incoming power for a pump being controlled should be connected to the odd terminal for that pump (P6). One wire of the pump will be connected to the even terminal. The other wire from the pump will connect to the other wire of the incoming power for that pump. For pumps and valves operated from 120 or 240VAC, the ground wires should be tied to the ground of the incoming power. The remaining pump and valves can be connected in the same manner. See Figures 3, 4, 5 & 6 for sample wiring diagrams.

Pump Motor Wiring

The RO and auxiliary/repressurization pump motors are connected to the terminal strip P6. The control relays for these pumps can control up to 20A directly or larger pump motors through appropriate motor starters. The control relays provide a contact closure and do not supply power. The RO pump motor connections are to P6, terminals "RO PUMP". The Aux/RP pump motor connections are to P6, terminals "AUX PUMP".

Inlet and Flush Valve Wiring

An inlet valve relay is provided to control the inlet valve. A flush valve relay is provided to allow a flush operation to be controlled by a tank full condition or by a periodic time function. These relays provide both normally open and normally closed contacts to operate either solenoid or motor driven valves. Each relay can be connected to whatever voltage is required for its corresponding valve. The inlet valve connections are to P6, terminals "INLET V.".The flush valve connections are to P6, terminals "FLUSH V.". The inlet relay can also be used to operate a motor starter for a booster pump in addition to an inlet valve.

TDS/Conductivity Cell Wiring

For accurate TDS/Conductivity readings, the cell should be installed in a tee fitting where a continuous flow of water passes over the cell and no air can be trapped around the cell. Refer to Figure 7 for example installation. The permeate TDS/Conductivity cell is connected with five wires to the plug-in terminal strip P5. The color coded wires are connected to the group of terminals labeled "P COND". Each wire must connect to the terminal labeled with its color's notation - i.e. connect the red wire to the terminal labeled "RD", black to "BK", etc., see Figure 3.

The optional feed TDS/Conductivity cell is connected with five wires to the plug-in terminal strip P7. The color coded wires are connected to the group of terminals labeled "F COND". Connect each wire to its corresponding color designated terminal as noted in Figure 3.

Each TDS/Conductivity cell generates a temperature output which may be displayed on the LCD display. Jumper J13 selects the temperature sensor in either the permeate or feed cell. If jumper J13 is in the position labeled "P", the permeate temperature will be displayed. If it is in position "F", the feed temperature will be displayed.

Analog Pressure Sensors

The analog pressure sensors are connected to P5. Dip Switch 1 should be moved to the "ON" position to enable reading of the analog pressure sensors and the jumper for each sensor (J6-J9) should be removed for each sensor installed. The switches and jumpers are pre-configured by the factory if the sensors are ordered with the unit. If the optional flow metering is installed, the flow meter interface board may be removed to allow easier wiring of the analog sensors. The plug-in terminal strip (P5) may also be unplugged for the same reason.

Feed Pressure Sensor

The feed pressure sensor should be installed downstream from the pre-filters and inlet valve and before the inlet side of the RO pump. The feed pressure sensor wires connect to the P5 terminals labeled "A1". The red wire connects to "RD" and the black wire to "BK". Jumper J6 should be removed to enable this sensor.

Pump Pressure Sensor

The pump pressure sensor is installed on the discharge side of the RO pump. The pump pressure sensor wires connect to the P5 terminals labeled "A2". The red wire connects to "RD" and the black wire to "BK". Jumper J7 should be removed to enable this sensor.

Prefilter Differential Pressure Sensor

The prefilter differential pressure sensor is installed upstream of the prefilters. The prefilter pressure sensor wires connect to P5 "A3". The red wire connects to "RD" and the black wire to "BK". Jumper J8 should be removed to enable this sensor.

Membrane Differential Pressure Sensor

The membrane differential pressure sensor is installed in the concentrate line of the membrane array. The membrane differential pressure sensor wires connect to P5 "A4". The red wire connects to "RD"
and the black wire to "BK". Jumper J9 should be removed to enable this sensor.

Switch Inputs

Switch inputs are connected to P4. The connections for these inputs are not polarity sensitive and can be connected to either terminal. The switch inputs should be contact closures only. **NOTE:** Applying voltage to these terminals will damage the ROTrol II. The Switches can be either normally open or normally closed in any combination. Setpoint 54 selects whether an input looks for a normally closed or normally open switch to activate the input. The following table lists the values used to program Setpoint 54 to select which switches are normally open (N.O.) or normally closed (N.C.). Setpoint 54 is defaulted to 00 which programs all switches as normally open. Normally open means that a switch is open when not activated and closed when it is activated. Normally closed switches operate opposite from normally open.

SWITCH	N.O.	N.C.	
FEED PRESSURE	0	1	
PUMP PRESSURE	0	2	
TANK FULL/PUMP OFF	0	4	
TANK LOW	0	8	
TANK FULL/PUMP ON	0	16	
PRETREAT LOCKOUT	0	32	
		SETPOINT 54	

Figure 2

Select the type of switch used for each input and put that value in the far right column. Add the values and program this value in Setpoint 54. For example, if the Low Pressure and Pretreat switches were normally closed and all others were normally open, the value programmed in Setpoint 54 would be 1 + 32 = 33.

****** WARNING ! DO NOT CONNECT POWERED SIGNALS TO THESE INPUTS ******

Tank Full/Pump OFF Switch

The tank full level switch or in dual tank full switch systems, the upper tank full switch connects to the P4 terminals labeled "T.F. P. OFF". When this switch activates, the unit will shutdown for tank full.

Tank Full/Pump ON Switch

In dual tank full switch systems, the lower tank full level switch connects to the P4 terminals "T.F. P. ON". When dual tank full switches are selected, and both the tank full/pump OFF and the tank full/pump ON switches are not

activated, the RO unit will operate.

Tank Low Switch

The tank low switch connects to the P4 terminals "TANK LOW".

Low Feed Pressure Switch

In systems with no feed pressure sensor or where a low pressure switch in addition to the feed pressure sensor is required, the low feed pressure switch connects to the P4 terminals "LOW PRESS".

High Pump Pressure Switch

In systems with no pump pressure sensor or where a high pressure switch in addition to the pump pressure sensor is required, the high pump pressure switch connects the P4 terminals "HIGH PRESS".

Pretreat Lockout Switch

In systems where it is desired to shutdown the RO unit when a pre- treatment system is out of service, a lockout switch can be wired to the P4 terminals "P.T. L.O.". The pretreatment equipment must provide a switch output when out of service.

Alarm/Divert Outputs

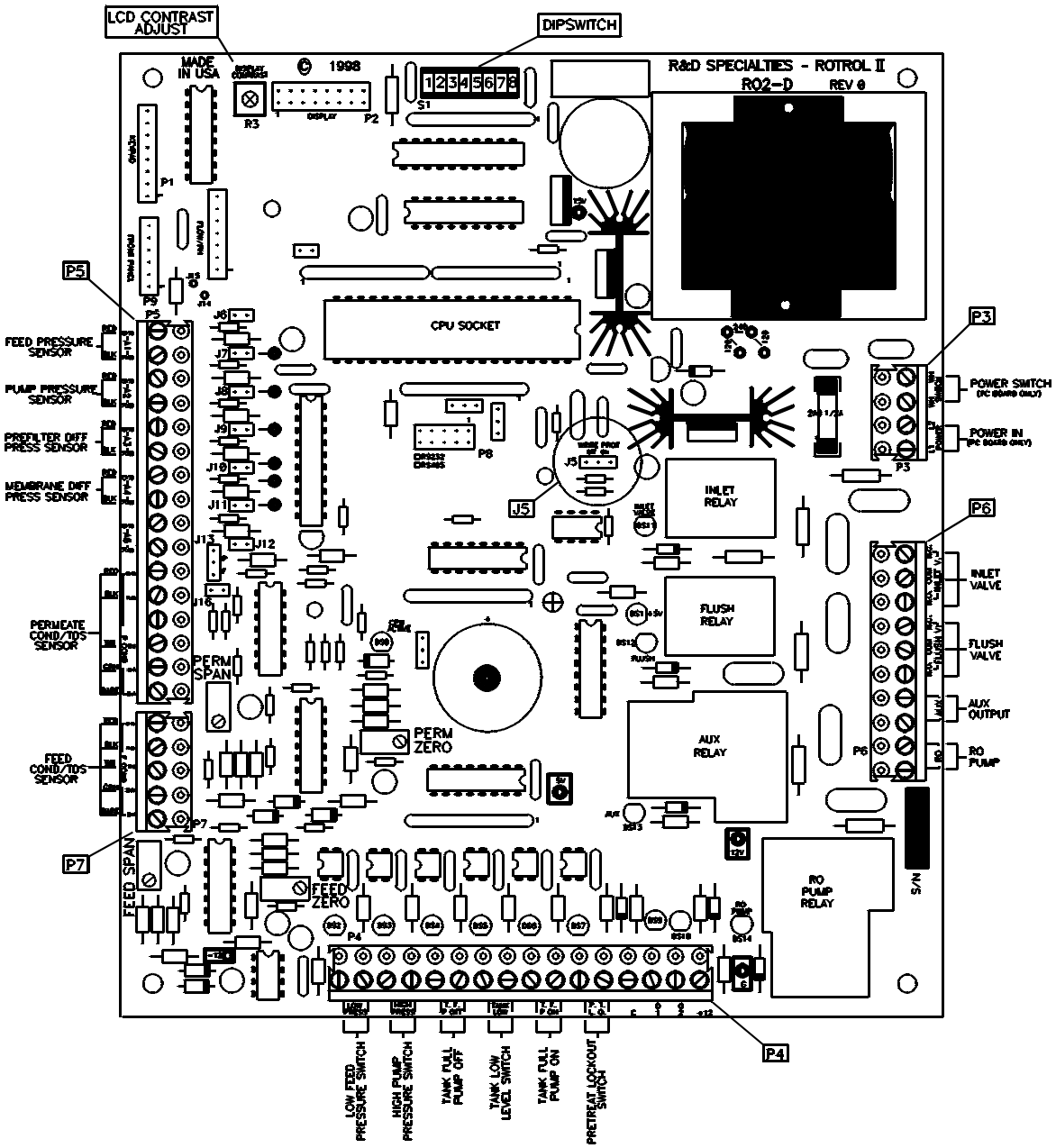
An alarm output and a divert output are available on P4. These outputs are open collector transistor outputs that pull to ground when active. The maximum load limit for each output is 100mA. These outputs can be used to signal a remote alarm unit such as R & D Specialties RA series of remote alarms or can operate an external 12VDC relay. An optional relay expander board is available that provides a SPDT relay output for each of these outputs. Refer to the Alarm/Divert Relay section for more information on this option.

Alarm Output

The alarm output is available at P4, pin 14 (O1). This output can be used to signal a R & D Specialties RA series of remote alarm by using the common at P4, pin 13 (C) and the alarm output at P4, pin 14 (O1). An external 12VDC relay can be connected to this output by connecting 1 side of the relay coil to P4, pin 14 (O1) and the other side of the relay coil to P4, pin 16 (+12).

Divert Output

The divert output is available at P4, pin 15 (O2). This output can be used to signal a R & D Specialties RA series of remote alarm by using the common at P4, pin 13 (C) and the divert output at P4, pin 15 (O2). An external 12VDC relay can be connected to this output by connecting 1 side of the relay coil to P4, pin 15 (O2) and the other side of the relay coil to P4, pin 16 (+12).



ROTROL IID CIRCUIT BOARD LAYOUT

Figure 3

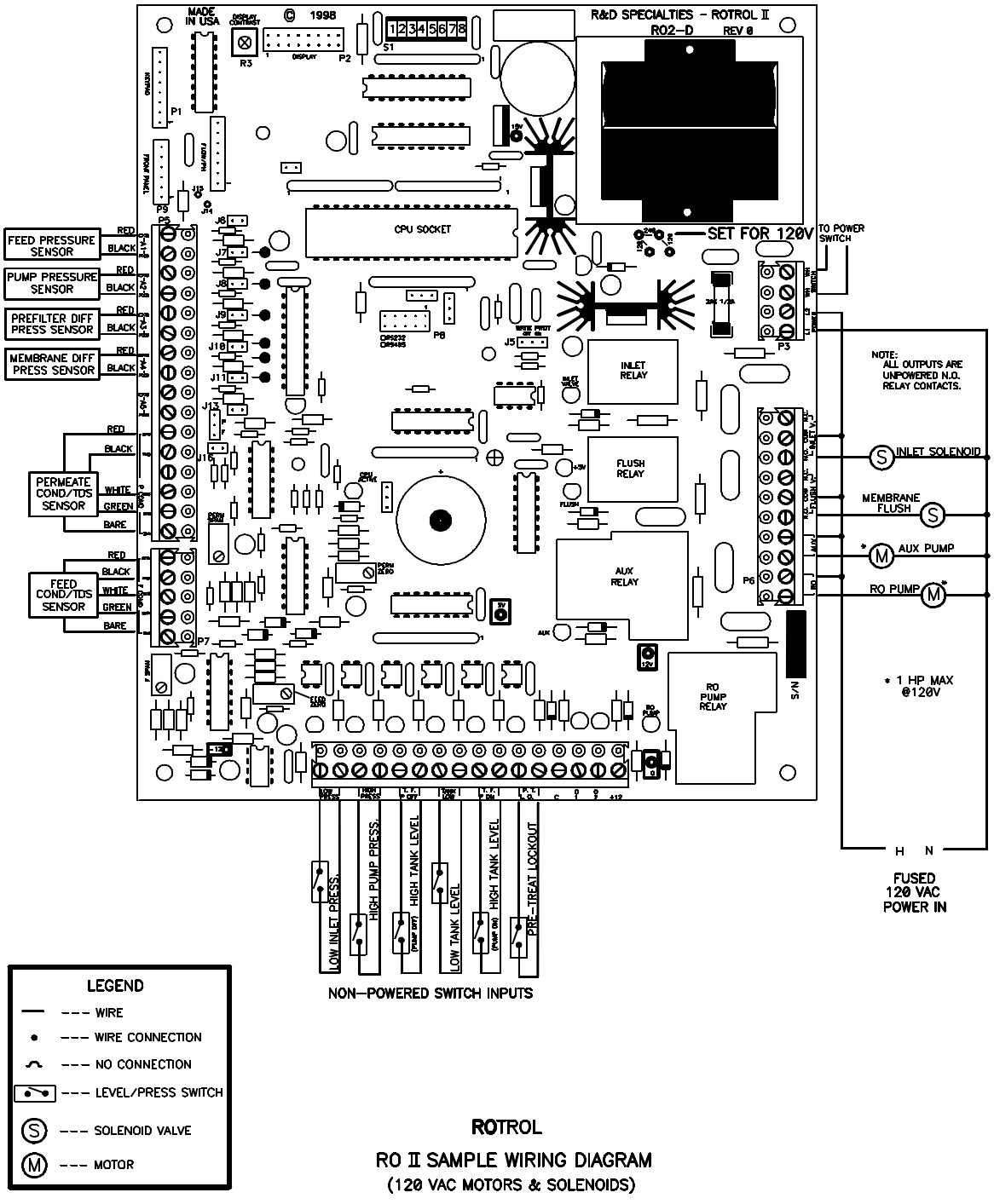

MADE IN USA
© 1998
R&D SPECIALTIES - ROTROL II
RO2-D REV B
CPU SOCKET
SET FOR 120V
TO POWER SWITCH
FEED PRESSURE SENSOR
PUMP PRESSURE SENSOR
PREFILTER DIFF PRESS SENSOR
MEMBRANE DIFF PRESS SENSOR
PERMEATE COND/TDS SENSOR
FEED COND/TDS SENSOR
RED
BLACK
WHITE
GREEN
BARE
INLET RELAY
FLUSH RELAY
AUX RELAY
RO PUMP RELAY
NOTE: ALL OUTPUTS ARE UNPOWERED N.O. RELAY CONTACTS.
INLET SOLENOID
MEMBRANE FLUSH
AUX PUMP
RO PUMP
* 1 HP MAX @120V
H N
FUSED 120 VAC POWER IN
LOW INLET PRESS.
HIGH PUMP PRESS.
HIGH TANK LEVEL (PUMP OFF)
LOW TANK LEVEL
HIGH TANK LEVEL (PUMP ON)
PRE-TREAT LOCKOUT
NON-POWERED SWITCH INPUTS
LEGEND
--- WIRE
--- WIRE CONNECTION
--- NO CONNECTION
--- LEVEL/PRESS SWITCH
--- SOLENOID VALVE
--- MOTOR
ROTROL
RO II SAMPLE WIRING DIAGRAM
(120 VAC MOTORS & SOLENOIDS)

Figure 4

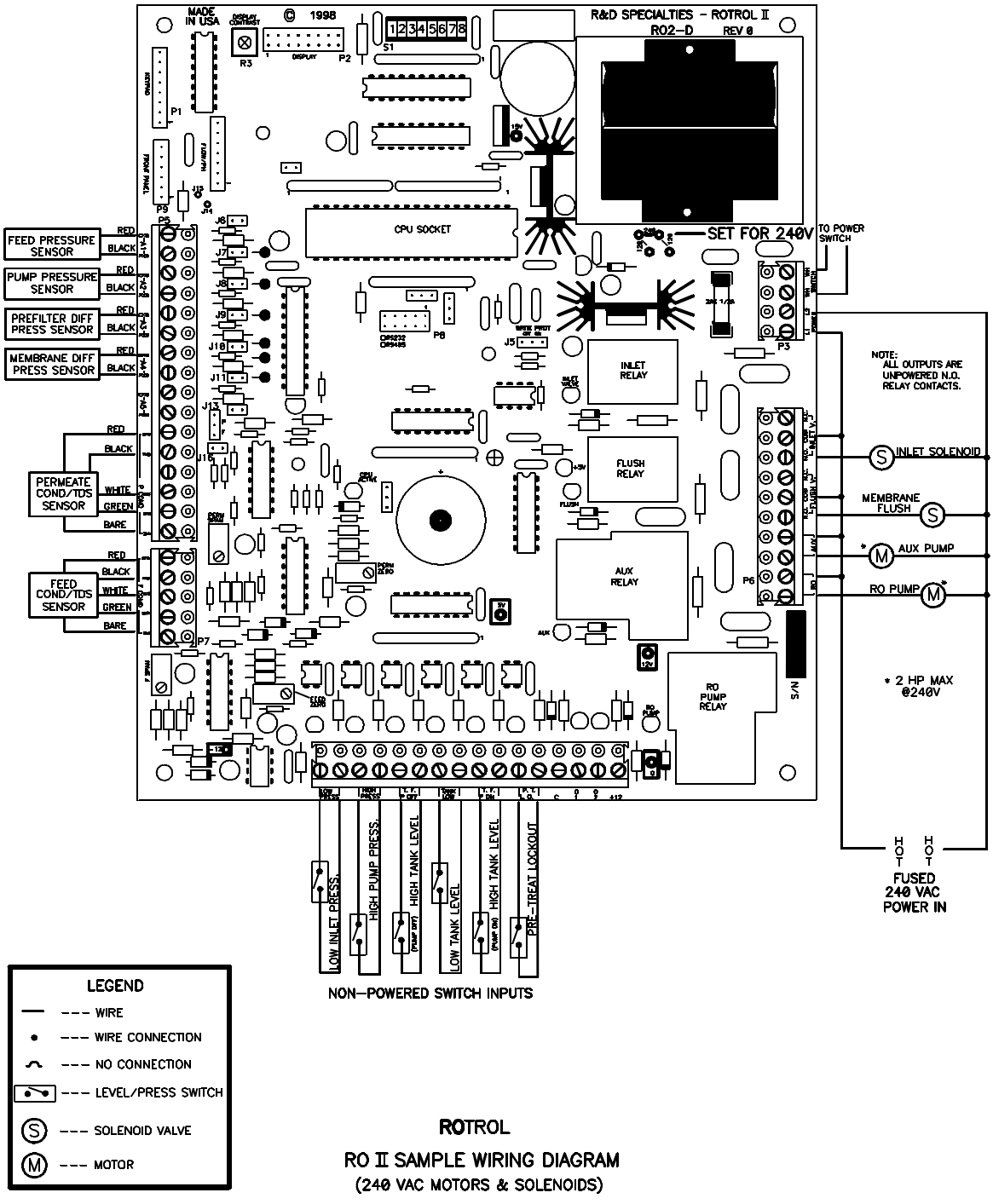

MADE IN USA
© 1998
R&D SPECIALTIES - ROTROL II
RO2-D REV B
CPU SOCKET
SET FOR 240V
TO POWER SWITCH
FEED PRESSURE SENSOR
PUMP PRESSURE SENSOR
PREFILTER DIFF PRESS SENSOR
MEMBRANE DIFF PRESS SENSOR
PERMEATE COND/TDS SENSOR
FEED COND/TDS SENSOR
RED
BLACK
WHITE
GREEN
BARE
INLET RELAY
FLUSH RELAY
AUX RELAY
RO PUMP RELAY
NOTE: ALL OUTPUTS ARE UNPOWERED N.O. RELAY CONTACTS.
INLET SOLENOID
MEMBRANE FLUSH
AUX PUMP
RO PUMP
* 2 HP MAX @240V
HOT
HOT
FUSED 240 VAC POWER IN
LOW INLET PRESS.
HIGH PUMP PRESS.
HIGH TANK LEVEL (PUMP OFF)
LOW TANK LEVEL
HIGH TANK LEVEL (PUMP ON)
PRE-TREAT LOCKOUT
NON-POWERED SWITCH INPUTS
LEGEND
--- WIRE
--- WIRE CONNECTION
--- NO CONNECTION
--- LEVEL/PRESS SWITCH
--- SOLENOID VALVE
--- MOTOR
ROTROL
RO II SAMPLE WIRING DIAGRAM
(240 VAC MOTORS & SOLENOIDS)

Figure 5

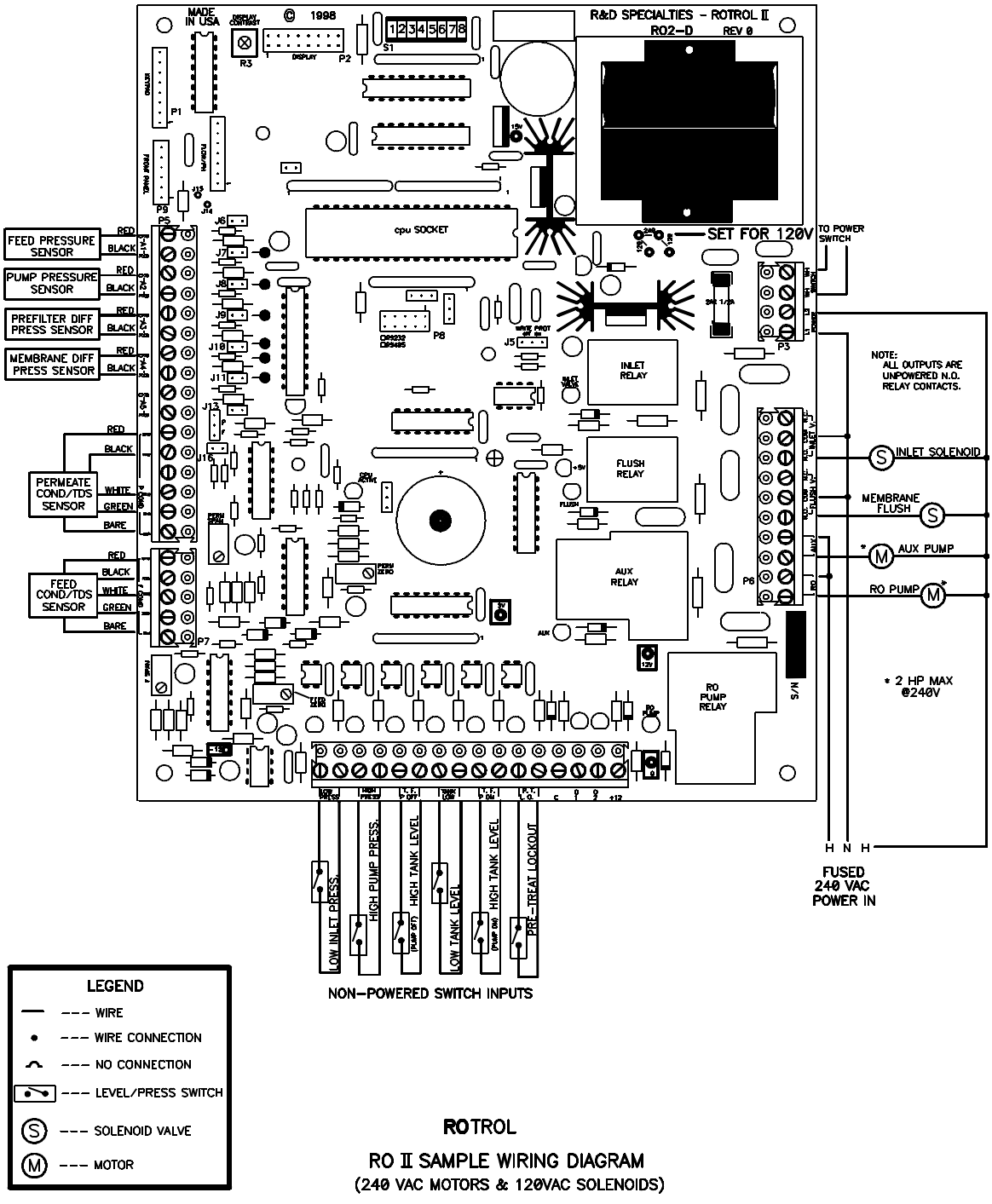

MADE IN USA
© 1998
R&D SPECIALTIES - ROTROL II
RO2-D REV 0
cpu SOCKET
SET FOR 120V
TO POWER SWITCH
FEED PRESSURE SENSOR
PUMP PRESSURE SENSOR
PREFILTER DIFF PRESS SENSOR
MEMBRANE DIFF PRESS SENSOR
PERMEATE COND/TDS SENSOR
FEED COND/TDS SENSOR
RED
BLACK
WHITE
GREEN
BARE
INLET RELAY
FLUSH RELAY
AUX RELAY
RO PUMP RELAY
NOTE: ALL OUTPUTS ARE UNPOWERED N.O. RELAY CONTACTS.
INLET SOLENOID
MEMBRANE FLUSH
AUX PUMP
RO PUMP
* 2 HP MAX @240V
H N H
FUSED 240 VAC POWER IN
LOW INLET PRESS.
HIGH PUMP PRESS.
HIGH TANK LEVEL
LOW TANK LEVEL
HIGH TANK LEVEL
PRE-TREAT LOCKOUT
NON-POWERED SWITCH INPUTS
LEGEND
--- WIRE
--- WIRE CONNECTION
--- NO CONNECTION
--- LEVEL/PRESS SWITCH
--- SOLENOID VALVE
--- MOTOR
ROTROL
RO II SAMPLE WIRING DIAGRAM
(240 VAC MOTORS & 120VAC SOLENOIDS)

Figure 6

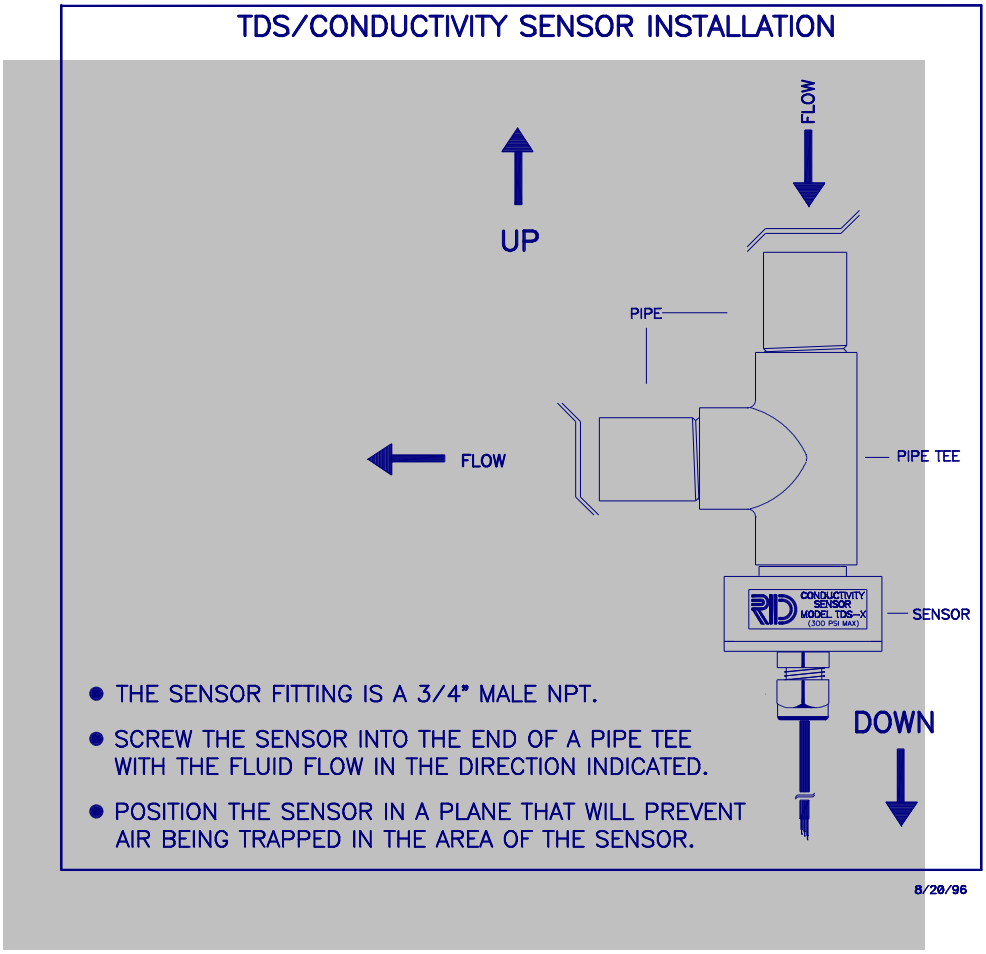

TDS/CONDUCTIVITY SENSOR INSTALLATION
FLOW
UP
PIPE
FLOW
PIPE TEE
CONDUCTIVITY SENSOR MODEL TDS-X (300 PSI MAX)
SENSOR
DOWN
THE SENSOR FITTING IS A 3/4" MALE NPT.
SCREW THE SENSOR INTO THE END OF A PIPE TEE WITH THE FLUID FLOW IN THE DIRECTION INDICATED.
POSITION THE SENSOR IN A PLANE THAT WILL PREVENT AIR BEING TRAPPED IN THE AREA OF THE SENSOR.
8/20/96

Figure 7

STANDARD SETPOINTS

SETPOINT	DESCRIPTION	RANGE	DEFAULT
01	Low Feed Pressure Limit - Sensor input lower than the programmed value will cause RO system shutdown. To disable, set to 00.	01-99 PSI/BAR	20
02	Low Feed Pressure Delay - The amount of time a low sensor input or a low switch input must be active before RO system shutdown occurs.	00-99 seconds	05
03	High Pump Pressure Limit - Sensor input higher than the programmed value will cause RO system shutdown. To disable, set to 0000.	001-9999 PSI/BAR	0220
04	High Pump Pressure Delay - The amount of time a high pressure sensor input or a high pressure switch input must be active before an RO system shutdown occurs.	01-99 seconds	05
05	Low Pump Pressure Limit - When the pump pressure drops below this limit with the RO unit operating, the alarm lamp will light and low pump pressure will show on the alarm screen. To disable, set to 000.	000-999 PSI/BAR	150
06	Maximum Prefilter Differential PSI - When the prefilter sensor pressure minus the low feed sensor pressure exceeds this value, the alarm lamp will light and high prefilter differential pressure will show on the alarm screen. To disable, set to 00.	01-99 PSI/BAR	20
07	Maximum Membrane Differential PSI - When the pump pressure sensor pressure minus the membrane pressure sensor exceeds this value, the alarm lamp will light and high membrane differential pressure will show on display. To disable, set to 00.	01-99 PSI/BAR	20
08	Not Used.		
09	Not Used.		

STANDARD SETPOINTS

SETPOINT	DESCRIPTION	RANGE	DEFAULT
10	High TDS/Cond Limit - When this value is met or exceeded, the alarm lamp will light and high TDS/Cond will show on alarm screen after the delay programmed in setpoint 11 has expired. To disable, set to 000.	001-999 PPM/uS	100
11	TDS/Cond Alarm Delay - When setpoint 10 has been exceeded, no alarm will be given until this time has expired.	001-999 seconds	030
12	High TDS/Cond Shutdown Delay - If the TDS/Cond shutdown is enabled with dipswitch 3, the shutdown will occur after this delay.	01-99 minutes	00
13	% Reject Limit - If the membrane rejection drops to or below this value, the alarm lamp will light and low % rejection will show on the alarm screen. To disable, set to 00.	00-99 %	80
14	Not Used.		
15	Not Used.		
16	Current Operating Hours - current number of hours of RO system operation.	00000-99999 hours	00000
17	Maximum Operating Hours - When the RO system operating hours exceed this value, the alarm lamp will light and max operating hours exceeded will show on the alarm screen. To disable, set to 00000.	00001-99999 hours	00000
18	RO Start Delay - The amount of time before the RO pump starts when any RO system shut down is cleared.	01-99 seconds	05
19	Aux Start Delay - The amount of time before the Aux relay starts when the tank low input clears.	01-99 minutes	15
20	Automatic Reset Timer - If the RO system is shutdown due to high pump pressure or low feed pressure, after the programmed amount of time, the RO system is automatically reset and the RO system will attempt to re-start after the RO start delay. To disable automatic reset, set to 00.	00-99 minutes	60

STANDARD SETPOINTS

SETPOINT	DESCRIPTION	RANGE	DEFAULT
21	Pretreatment Lockout Delay - The amount of time the pretreat lockout switch must be active before pretreat lockout is valid and the RO system shuts down.	00-99 seconds	05
22	Not Used.		
23	Not Used.		
24	Tank Full Delay - The amount of time the tank full/pump OFF switch input must be active before tank full is valid and the RO system shuts down.	01-99 seconds	05
25	Tank Full Restart Delay - When Dipswitch 2 is OFF, this delay is in minutes. If ON, the delay is in seconds.	01-99 seconds/minutes	15
26	Tank Full Override Time - When the Tank Full Override function is initiated, (Function 1), the tank full shutdown is overridden for the number of minutes in this setpoint.	0-9 minutes	3
27	Tank Low Delay - The amount of time the tank low switch input must be active before tank low is valid and the Aux system shuts down.	01-99 seconds	05
28	Not Used.		
29	Membrane Flush Time - The length of time the membrane will flush when membrane flush has been activated.	01-99 minutes	05
30	Membrane Flush Interval - The interval between flush operations. Only valid for op hour, elapsed time or off time flush.	00-99 hours	24
31	Flush Mode - Enables flush and selects the type of flush. To disable flush, set to 00	00-99	00
32	Not Used.		

STANDARD SETPOINTS

SETPOINT	DESCRIPTION	RANGE	DEFAULT
33	Temperature Limit - When the temperature exceeds this limit, after the temperature delay, the RO system will shut down until reset. To disable, set to 000.	000-150 °F/C	120
34	Temperature Delay - The amount of time the temperature limit must be exceeded before RO system shutdown occurs.	00-99 seconds	05
35	Temp Offset - Provides a plus or minus offset to the temperature reading. When set to 5, the offset is 0. The displayed temperature is increased for each number above 5 and decreased for each number below 5.	0-9	5
36-43	See flow section of manual.		
44	Not Used.		
45-49	See pH section of manual.		
50	Not Used.		
51	Pressure Unit of Measure - Selects PSI or bar as unit of measure.	0-1	0
52	Temperature Unit of Measure - Selects degrees °F or °C as unit of measure.	0-1	0
53	Flow Unit of Measure - Selects gallons or liters as unit of measure. If changed, the K-factor for each flow sensor may need to be changed.	0-1	0
54	Switch Select - Selects whether switch inputs or normally open or normally closed.	0-255	000
55	Pump Range - Selects 500 or 1500 pump pressure range. NOTE:Must have correct range sensor.	0-1	0
56	Shutdown Disable - Allows the low feed pressure, high pump pressure and high temperature shutdowns to be disabled configured for alarm only.	0-9	0
57	Unit # - Unit number used when comm option is used.	0-9	1
58-61	See ORP section of manual		
57-64	Not Used.		

TO DISPLAY OR CHANGE SETPOINTS

1. Refer to Figure 3 for location of J5. Move the shorting block J5(WRITE PROT) to the OFF position (center and left pins). If J5 is in the write protected position and an attempt is made to change a setpoint, WRITE PROTECTED will show on the display and the long error beep will be heard. CAUTION: J5 must be returned to the ON position to secure the memory from inadvertent changes.

2. Press the "Setpoint" key.

3. Enter the 2 digit setpoint number.

3. The setpoint will be displayed. Press the "cancel" key to return to the main screen; or,

4. To change the setpoint, enter the new value for the setpoint and then press the "Enter" key.

5. The ROTrol II will beep twice if the change is accepted or one long beep if an error is made. The setpoint value entered must have the correct number of digits. For example, the value entered for maximum operating hours must have 5 digits. Precede your entry by zeros if needed.

6. When finished with all setpoint entries, move the write protect jumper J5 back to the ON position. (center and right pins)

STANDARD FUNCTIONS

FUNCTION DESCRIPTION

1 Tank Full Override - Allows the RO unit to be turned on when it is shut down due to a tank full condition. When the override is initiated, the RO unit will operate for the amount of time programmed in setpoint 26.

2 Manual Flush - Manually initiates a flush cycle.

3 Startup Screen - Enables special screen that shows all sensor readings.

FUNCTION OPERATION

1. Press the "Function" key.

2. Press the number of the function you want to select (1-9).

3. Press the "Enter" key to activate the function or "Cancel" to abort the function.

DIPSWITCH SETTINGS

Switch	Off	On
1	Analog pressure inputs disabled	Analog pressure inputs enabled
2	Single tank full switch Long restart time	Dual tank full switches (Pump ON/Pump OFF) short restart
3	Alarm lamp on high TDS/ Conductivity	RO system shutdown on high TDS/Conductivity
4	RO pump on during flush	RO pump off during flush
5	Inlet valve open during flush	Inlet valve closed during flush
6	Flow metering disabled	Flow metering enabled
7	Not used	
8	Not used	

SYSTEM OPERATION

General Operation

On power up, if the RO pump switch is ON, the inlet control relay will activate and the RO start delay programmed in Setpoint 18 (RO Start Delay) will begin. If no alarms are active the RO pump control relay will operate when the delay times out and the display will show the status of the RO system. Refer to the SCREEN DESCRIPTIONS section of the manual for a description of the various display screens.

Shutdown conditions are indicated by a flashing red alarm lamp and audible warning beeper. The cause of the shutdown is shown on the first line of the display. Warnings that do not shut down the system are indicated by a steady red alarm lamp. The status of any warnings can be displayed on the warnings screen by pushing the "Display" key on the keypad.

If no warnings are active or if the "Display" key is pushed again, a second screen is shown that shows additional data. If the optional flow sensing is enabled, pushing the "Display" key again will show the flow data screen. Pushing the "Display" key again returns the display to the main screen.

Tank Full Operation

Two types of tank full operation are available. If Dipswitch 2 is OFF, single switch tank full operation is enabled. In this mode, if the tank full/pump off switch input is activated, after the time delay programmed in setpoint 24 (Tank Full Delay), the RO control relay will open, shutting down the RO pump. The display will now show TANK FULL. When the tank full condition is removed, the delay programmed in setpoint 25 (Tank Full Restart Delay) will be started. This delay is in minutes. When the delay times out, the RO unit will restart. The remaining delay time will be displayed during the delay period.

If Dipswitch 2 is ON, the dual tank full switch operation is enabled. In this mode, 2 switches are used to provide pump off/pump on operation. When the upper switch is activated, the RO control relay will open, shutting down the RO pump. Tank full will show on the display. When the tank level drops and both the upper and lower switches are no longer activated, the RO control relay will operate after the Tank Full Start Delay programmed in setpoint 25. This time delay is in seconds and will be shown on the display during the delay period.

Tank Full Override

Function 1, (Tank Full Override), allows the RO unit to be operated when it has shut down due to a tank full condition. When this function is initiated, the RO unit will operate for the number of minutes programmed in setpoint 26 (Tank Full Override Time). At the end of this time, the RO unit will then shut down if the tank full condition is still active. This feature allows the RO unit performance to be checked, or samples to be taken, when the RO unit is not operating due to a full tank.

Low Feed/High Pump Pressure Operation

If dipswitch 1 is OFF, only the pressure switch inputs are active. If it is ON, the switch inputs and the analog pressure sensor inputs are enabled. If the low feed pressure switch input becomes active or, if the analog inputs are enabled and the feed pressure sensor input drops below the value programmed in setpoint 01 (Low Feed Pressure), the low feed pressure shutdown will occur after the time delay programmed in setpoint 02 (Low Feed Delay). NOTE: The low feed pressure alarm generated by the pressure sensor can be disabled by programming Setpoint 01 to 00. The RO Pump control relay will open shutting down the RO pump, and the alarm will begin to sound. LOW FEED PRESSURE will show on the display and the alarm lamp will flash. The RO system will remain shutdown until reset.

High pump pressure operates in the same manner, except the pump pressure sensor input must exceed the value programmed in setpoint 03 (High Pump Pressure) and the delay is programmed in setpoint 04 (High Pump Delay). NOTE: The high pump pressure alarm generated by the pressure sensor can be disabled by programming Setpoint 03 to 0000.

If the system shuts down for a low or high pressure fault and the Setpoint 20 (Auto Reset Time) is programmed to a time other than 0, the time remaining before the system attempts the automatic restart is indicated after the cause of the shutdown on the first line of the display. If Setpoint 20 is programmed to 00, the low or high pressure shut downs can only be reset by pressing the Reset key.

Low Pump Pressure

The pump pressure sensor has an additional setpoint for a low pump discharge pressure alarm. When the RO unit is operating, if the pump pressure drops below the value programmed in setpoint 05 (Low Pump Pressure Limit), the alarm lamp will light and LOW PUMP PRESSURE will show on the alarm display. This alarm is disabled when the RO pump is off and during flush. This setpoint does not cause RO system shutdown. If Setpoint 05 is programmed to 000, the low pump pressure alarm is disabled.

Differential Pressure Alarms

If the optional differential pressure sensors are installed, high differential pressure setpoints 06 (Prefilter Differential) and 07 (Max Membrane Differential) are provided. If the sensors record a pressure drop across the prefilter or the membrane that exceeds the setpoints, the alarm lamp will light and the alarm display will show the setpoint that was exceeded. Programming these 2 setpoints to 00 will disable these alarms.

High TDS/Conductivity Alarm/Shutdown

If Dipswitch 3 is OFF and the permeate TDS/Conductivity reading exceeds the value programmed in setpoint 10 (High TDS/Conductivity Limit), the delay programmed in Setpoint 11 (TDS/Cond Alarm Delay) is started. When this time delay times out, the alarm lamp will flash, the audible alarm will sound and high TDS/Conductivity will show on the alarm display. If Dipswitch 3 is ON and the high permeate TDS/Conductivity limit is exceeded for the delay programmed in setpoint 12 (High TDS/Conductivity Shutdown Delay), the RO system will shut down until reset. Programming Setpoint 10 to 000 will disable the high TDS/Conductivity alarm. When the unit is in flush or when the RO unit is off

due to any shut down condition, the TDS/Conductivity alarm is disabled.

% Rejection Limit

If the optional feed TDS/Conductivity monitor is installed, feed TDS/Conductivity and membrane % rejection are displayed. If the membrane rejection drops below the value programmed in setpoint 13 (% Reject Limit), the alarm lamp will light and LOW PERCENT REJECTION will show on the alarm screen. Programming Setpoint 13 to 00 will disable the percent rejection alarm.

Shutdown Disable

The low feed pressure, high pump pressure and high temperature shutdowns can be disabled and configured for alarm only by programming Setpoint 56 (Shutdown Disable) with the correct value. The default for this setpoint is 0, which enables all 3 shutdowns. Each shutdown has a factor. The factor for low feed pressure is 1, the high pump pressure factor is 2 and the high temperature factor is 4. Add the factors for the shutdowns that are to be disabled and program this value in Setpoint 56. For example, to disable the shutdowns for high pump pressure and high temperature, the value programmed in Setpoint 56 would be 2+4=6.

RO System Shutdown Reset

Low feed or high pump pressure shutdowns can be reset either manually or automatically. The high TDS/conductivity shutdown and the high feed temp shutdown can only be reset manually. For manual reset, push the "RESET" key on the front panel twice. Automatic reset is controlled by setpoint 20 (Automatic Reset Timer). If programmed to 00, automatic reset is disabled and all shutdowns must be reset manually. If a time is programmed into this setpoint, when the RO system is shutdown due to low feed or high pump pressure, the automatic reset timer is activated. When the timer times out, the RO system is reset and the RO system will operate if the fault causing the shutdown has cleared.

Pretreatment Lockout

In systems where softeners or filters are used ahead of the RO unit, a pretreat lockout input is provided to shutdown the RO unit. When a pretreat unit goes out of service due to regeneration or backwash and the pretreat lockout contact activates, the RO unit will shutdown after the delay programmed in setpoint 21 (Pretreat Lockout Delay). When the contact activation is removed, the RO unit will automatically restart.

Membrane Flush

Several modes of membrane flush are available. In all modes, the RO system will flush for the amount of time programmed in setpoint 29 (Membrane Flush Time). The flush mode is selected using Setpoint 31 (Flush Mode). The Flush Table, (Figure 8), shows the various types of flush modes and the value that must be programmed into Setpoint 31 to enable the selected flush mode. The operation of each flush mode is described below.

FLUSH TABLE

FLUSH MODE	VALUE
NO FLUSH	00
TANK FULL	03
OP HOURS	05
OP HOURS/TANK FULL	07
ELAPSED TIME	09
ELAPSED TIME/TANK FULL	11
OFF HOURS	13
OFF HOURS/TANK FULL	15
RO START/STOP	17

Figure 8

TANK FULL - The RO unit will go into flush each time a tank full condition occurs.

OP HOURS - A flush will occur each time the RO pump has operated the number of hours programmed in Setpoint 30 (Flush Interval).

ELAPSED TIME - A flush will occur each time the number of hours programmed in Setpoint 30 (Flush Interval) has passed.

OFF HOURS - A flush will occur each time the RO pump has been off for the number of hours programmed in Setpoint 30 (Flush Interval). NOTE: If the unit is off due to a pretreat lockout condition, the RO will not flush.

START/STOP - The RO unit will flush each time the RO starts and stops.

The tank full flush can be combined with any of the 3 interval flush types. A manual flush may be initiated at any time by selecting Function 2.

Auxiliary/Repressurization Pump Operation

On power up, the Aux/RP system will start immediately if the Aux/RP switch is on and the tank low input is not active.

Tank Low Operation

If the tank low switch input is activated, the Aux/RP control relay will open after the delay programmed in setpoint 27 (Tank Low Delay). When the input becomes inactive, the Aux/RP control relay will operate after the delay programmed in setpoint 19 (Aux Start Delay).

Operating Hours

The counter that shows the current operating hours is displayed on screen 2 (Figure 10). This is the number of hours that the RO pump has run. This counter can be cleared or set to a specific number by programming Setpoint 16 (Current Op Hours). Setpoint 17 (Maximum Op Hours) can be programmed to give a warning when the unit has operated for the number of hours programmed in this setpoint. If programmed to 00000, this warning is disabled.

Temperature Alarm

Setpoint 33 (Temperature Limit) can be programmed to shut down the unit if the measured temperature exceeds this setpoint. A time delay for this limit is provided with Setpoint 34 (Temperature Delay). If Setpoint 33 is programmed to 000, this alarm is disabled.

Sensor Unit of Measure

Setpoints 51 (PSI/BAR), 52 (F/C) and 53 (GPM/LPM/M3H) allow the pressure, temperature and flow unit of measure to be changed to meet customer requirements. NOTE: If the flow unit of measure is changed, the K-factor for each flow sensor must also be changed.

Alarm Output

The alarm output available at P4, pin 14 (O1) is active whenever any alarm or shut down condition is active. DS9 is lit whenever this output is active.

Divert Output

The divert output available at P4, Pin 15 (O2) is active whenever the TDS/Conductivity reading has exceeded Setpoint 10. The RO unit does not need to be running for this output to be active. DS10 is lit whenever this output is active.

SCREEN DESCRIPTIONS

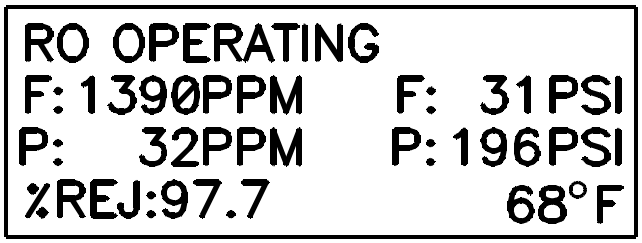


Figure 9

Screen 1

Screen 1 shows the standard operating conditions for the RO unit. The first line of screen 1 shows the status of the RO unit. The following is a list of status messages with explanations.

RO OPERATING - The RO unit is on and operating properly.

RO ON DELAY 10 - The inlet solenoid is open and the number is the remaining delay in seconds before the RO pump starts.

RO OFF - The RO pump is turned off with the RO pump switch.

TANK FULL 15 - The RO pump is shutdown due to a tank full condition. The number after tank full is the delay in minutes before the RO starts after the tank full condition clears.

HIGH PUMP PRESS 60 - The RO pump is shutdown due to a high pump discharge pressure condition. The number is the amount of time in minutes before the unit attempts to restart.

LOW FEED PRESS 60 - The RO pump is shutdown due to a low feed pressure condition. The number is the amount of time in minutes before the unit attempts to restart.

MEM FLUSH TIMER 5 - The RO unit is in the membrane flush mode and the number of minutes remaining in the flush mode.

HIGH TDS/COND - The RO unit has shutdown due to a high TDS/Conductivity condition.

PRETREAT LOCKOUT - The RO unit is shutdown because the pretreat system is out of service.

HI FEED TEMP - The RO unit has shutdown due to a high feed water temperature condition.

LO FEED pH - The RO unit has shutdown due to a low feed pH condition.

HI FEED pH - The RO unit has shutdown due to a high feed Ph condition.

Screen 1 also displays 6 other RO operating conditions.

F:1390PPM - If the optional feed sensor is installed, the feed water quality PPM will be displayed. If the unit of measure is microsiemens, the PPM will be replaced with uS. If the feed sensor is not installed the display will show F:----PPM. If the feed reading is out of range, the display will show F:^^^^.

P: 32PPM - The permeate water quality in PPM is shown. If the selected unit of measure is microsiemens, the PPM will be replaced with uS. If the permeate reading is out of range, the display will show P:^^^.

%REJ:97.7 - The percent rejection is calculated and displayed. If the feed sensor is not installed or if either sensor reading is out of range, the display will show %REJ:---.

F: 31PSI - If the optional feed pressure sensor is installed, the feed pressure in PSI or BAR will be shown. If the sensor is not installed, the display will show F: OK if the low pressure switch is not activated. If the low pressure switch becomes activated, the display will show F: LO.

P: 196PSI - If the optional pump pressure sensor is installed, the pump discharge pressure in PSI or BAR will be shown. If the sensor is not installed, the display will show P: OK if the high pressure switch is not activated. If the high pressure switch becomes activated, the display will show F: HI.

68°F - The permeate water temperature in °F or °C or if the feed sensor is installed, the feed water temperature.

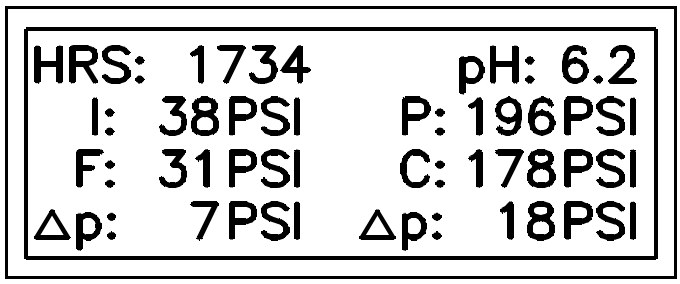


Figure 10

Screen 2

If no alarms are present, pressing the Display key advances the display to screen 2. Screen 2 displays additional data for the ROTrol II. On all pressure readings, the pressure shown will be in PSI or BAR based on the pressure unit of measure, setpoint 51.

HRS: 1734 - The number of hours the RO pump has operated.

pH: 6.2 - If the optional pH sensor is installed, the pH value is displayed.

I: 38PSI - If the optional inlet pressure sensor is installed, the inlet pressure is displayed. If this sensor is not installed, I:--- will show on the display.

F: 31PSI - If the optional feed pressure sensor is installed, the feed pressure is displayed. If this sensor is not installed, the display will show F: OK or F: LO depending on the status of the low pressure switch.

/\p: 7PSI - If the optional inlet and feed sensors are installed, the differential pressure is shown. Otherwise, /\p:--PSI is displayed.

P: 196PSI - If the optional pump pressure sensor is installed, the current pump pressure is displayed. If this sensor is not installed, the display will show P: OK or P: HI depending on the status of the high pressure switch.

C: 178PSI - If the optional concentrate pressure sensor is installed, the current concentrate pressure is displayed. If this sensor is not installed, C:--- is displayed.

/\p:18PSI - If the pump and concentrate sensors are installed, the differential pressure across the membrane is shown. Otherwise, /\p:--PSI is displayed.

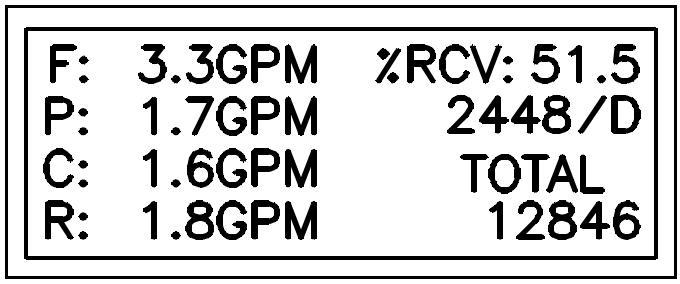


Figure 11

Screen 3

If the optional flow metering is installed, screen 3 shows the system flow data. Readings can be displayed for 3 flow meters. If a flow sensor is not used, the reading for that sensor and any readings based on that sensor will read 0.0. The readings will be in gallons or liters based on the flow unit of measure setpoint.

F: 3.3GPM - The feed flow rate. This reading is the sum of the permeate and concentrate flows.

P: 1.7GPM - The permeate flow rate.

C: 1.6GPM - The concentrate flow rate.

R: 1.8GPM - The recirculate flow rate.

%RCV:51.5 - The calculated percent recovery based on the current flow rates.

2448/D - The estimated permeate flow per day based on the current flow rate.

TOTAL - A totalizer of the permeate flow.
12846

Warning Screen

If the red alarm lamp is on steady, a non shutdown warning is active. To determine which warning is indicated, push the "display" key. The warning will be shown on the first line of the display. If multiple warnings are active, each warning condition will be displayed with a pause between each warning. The warnings and descriptions are:

HIGH TDS/COND - The high TDS/Conductivity setpoint has been exceeded.

OP HOURS EXCEEDED - The RO operating hours setpoint has been exceeded.

HI PREFIL DIFF PRESS - The prefilter differential pressure setpoint has been exceeded.

TANK LO - The tank low switch input is active.

HI MEMBR DIFF PRESS - The membrane differential pressure setpoint has been exceeded.

LO PUMP PRESS - The RO pump discharge pressure has dropped below the low pump pressure setpoint.

LO % REJECTION - The RO system percent rejection has dropped below the % rejection setpoint.

HI PERM FLOW - The permeate flow has exceeded the high permeate flow setpoint.

LO PERM FLOW - The permeate flow has dropped below the low permeate flow setpoint.

HI CNC FLOW - The concentrate flow has exceeded the high concentrate flow setpoint.

LO CNC FLOW - The concentrate flow has dropped below the low concentrate flow setpoint.

LO pH - The pH has dropped below the low pH alarm setpoint.

HI pH - The pH has exceeded the high pH alarm setpoint.

NOTE: Warnings can be cleared by correcting the source of the warning or by changing the setpoint associated with the warning.

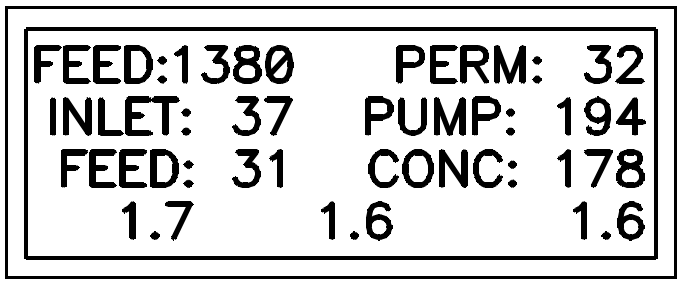


Figure 12

Startup Screen

The startup screen can be utilized during initial system startup to display all of the sensor readings on 1 screen. Pressing the Display key exits the startup screen. If a sensor is not installed, the display for that sensor will show ^^^.

Line 1 of the display shows the TDS/Conductivity values.

FEED:1380 - The feed water PPM/uS.

PERM: 32 - The permeate water PPM/uS.

Line 2 of the display shows the inlet and pump discharge pressures.

INLET: 37 - The inlet pressure.

PUMP: 194 - The pump discharge pressure.

Line 3 of the display shows the pump feed and concentrate pressures.

FEED: 31 - The pump feed pressure.

CONC: 178 - The concentrate pressure.

Line 4 of the display shows the system flow rates.

1.7 - The permeate flow.

1.6 - The concentrate flow.

1.6 - The recirculate flow.

ADJUSTMENTS

TDS/Conductivity Calibration

To calibrate the permeate TDS/Conductivity , adjust the permeate TDS/Conductivity zero (PERM ZERO) control for a reading of zero on the display with the cell clean and dry. Refer to Figure 3 for the location of the adjustments. Immerse the cell in a test solution with a known TDS or conductivity value and adjust the permeate TDS/Conductivity span (P SPAN) control so the display reads the correct TDS or conductivity for the solution. The optional feed TDS/Conductivity is calibrated in the same manner using "FEED ZERO" and "F SPAN".

If the unit is in service (cells installed), each cell may be calibrated by disconnecting the green wire of the cell from the terminal strip and adjusting the corresponding ZERO control to obtain a zero reading on the RO II's display. Reconnect the green wire and start up the RO unit. Collect a sample of the water circulating through each cell, measure the TDS/Conductivity of the sample with a calibrated TDS/Conductivity meter, then adjust the appropriate SPAN control to get the correct reading on the RO II display for each cell.

Display Adjustment

The "DISPLAY CONTRAST" control can be used to adjust the display contrast for the clearest display for the viewing conditions in which the ROTrol II is mounted. Refer to Figure 3 for the contrast control's location.

FLOW METERING

The optional flow metering allows permeate, concentrate, and recirculate flows to be monitored and displayed by the ROTrol II. Setpoints are provided for calibration for various pipe sizes and flow conditions. Setpoints are also provided to program high and low flow limit warnings for permeate and concentrate flow.

The flow meter interface PC board is mounted to the main board in the upper left corner of the board (see Figure 13). The flow meter interface board and the optional pH board may be removed to facilitate the wiring of the analog sensors to their terminal strip. To remove the pH board, remove the 2 mounting screws holding the board. Lift straight up on the pH board to remove it from the connector. To remove the flow board, remove the three screws or if the pH board was removed, the 2 screws and 1 spacer, holding the flow meter interface board and then lift straight up on the board to unplug it from the connector. After wiring the analog sensors, the board is reinstalled by aligning the pins of the connector with the holes in the bottom of the meter interface board and pushing the board into place. The mounting screws are then installed to secure the board.

Flow Sensor Wiring

A maximum of three flow sensors may be installed. Each sensor is wired to its corresponding terminal strip on the flow interface board. For Signet type flow sensors the wires connect as follows. The red wire to the top terminal, the black wire to the middle terminal, and the shield wire to the bottom terminal (see Figure 13). The jumper above each terminal block should be connected to the middle and right pins for most Signet sensors.

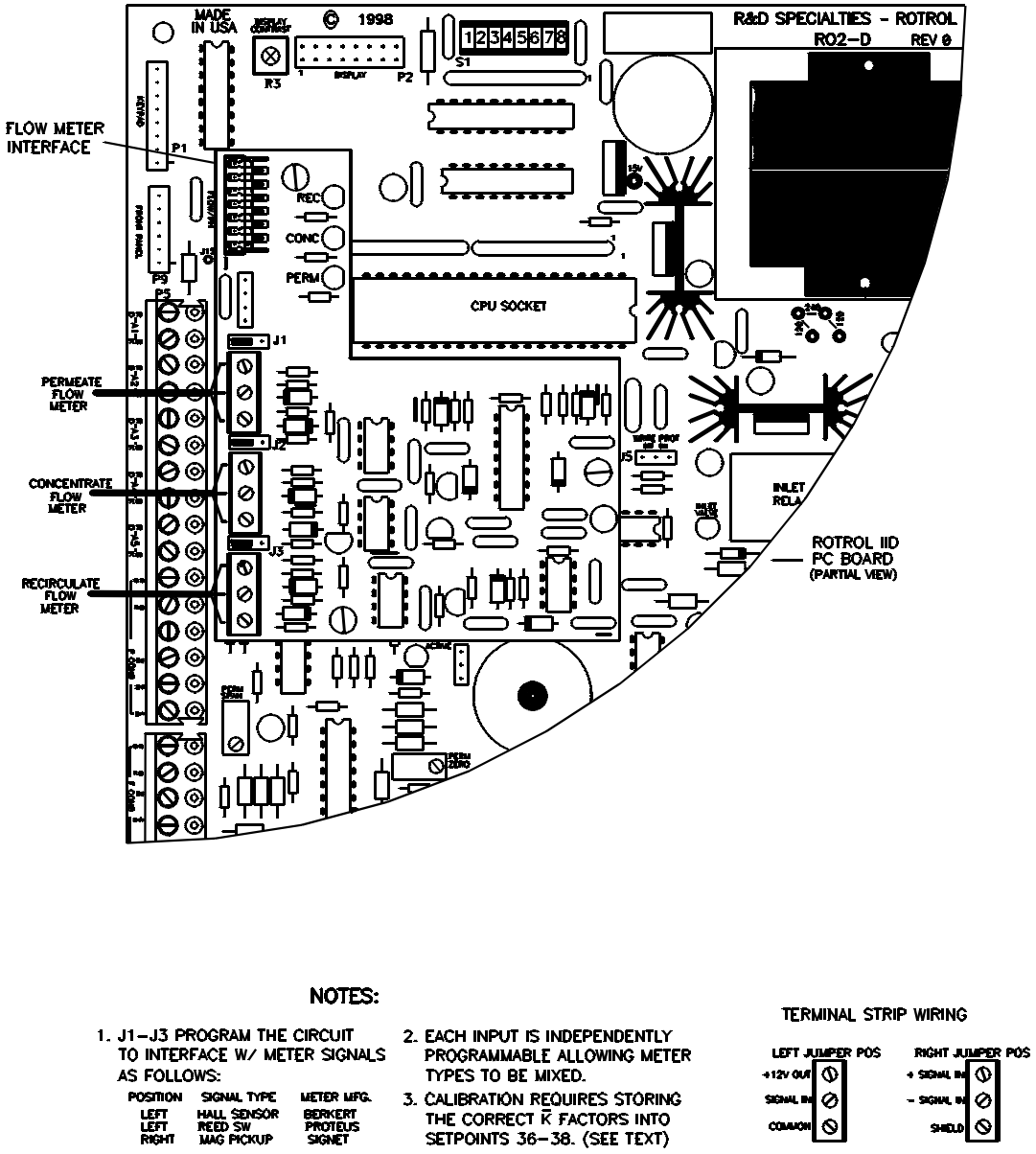
For Burkert flow sensors, connect the red wire to the top terminal, the black wire to the middle terminal, and the shield wire to the bottom terminal. The jumpers should be connected to the middle and left pins for Burkert sensors.

For Blue-White flow sensors, connect the red wire to the top terminal, the shield wire to the middle terminal, and the black wire to the bottom terminal. The jumpers should be connected to the middle and left pins for Blue-White sensors.

Consult R & D Specialties for wiring instructions for other types of flow sensors.

Flow Meter Calibration

For each flow sensor installed, the corresponding meter factor setpoints should be programmed. The meter factor is determined by the pipe size, type of fitting the sensor is mounted in and whether the flow is in GPM, LPM or M3H. The meter factors may need to be adjusted to compensate for flow differences under actual conditions. The K-factor is entered as a 4 digit number. If the flow rate indicated is too low, the meter factor should be lowered. If the rate is too high the meter factor should be raised. Refer to Figure 14. The displayed flow can be in GPM, LPM or M3H as selected by Setpoint 53 (Flow Unit of Measure). Program Setpoint 53 to 0 for GPM, 1 for LPM or 2 for M3H. **NOTE:** The K-factor for each flow sensor may need to be changed when the unit of measure is changed. If the K-factor for a meter is programmed to 000000, that meter is disabled and any reading based on that meter will show as dashes on the display.


FLOW METER INTERFACE
PERMEATE FLOW METER
CONCENTRATE FLOW METER
RECIRCULATE FLOW METER
MADE IN USA
© 1998
R&D SPECIALTIES - ROTROL
RO2-D REV 0
1 2 3 4 5 6 7 8
CPU SOCKET
INLET RELA
ROTROL IID PC BOARD (PARTIAL VIEW)
NOTES:
1. J1-J3 PROGRAM THE CIRCUIT TO INTERFACE W/ METER SIGNALS AS FOLLOWS:
POSITION SIGNAL TYPE METER MFG.
LEFT HALL SENSOR BERKERT
LEFT REED SW PROTEUS
RIGHT MAG PICKUP SIGNET
2. EACH INPUT IS INDEPENDENTLY PROGRAMMABLE ALLOWING METER TYPES TO BE MIXED.
3. CALIBRATION REQUIRES STORING THE CORRECT K FACTORS INTO SETPOINTS 36-38. (SEE TEXT)
TERMINAL STRIP WIRING
LEFT JUMPER POS
+12V OUT
SIGNAL IN
COMMON
RIGHT JUMPER POS
+ SIGNAL IN
- SIGNAL IN
SHIELD

FLOW METER INTERFACE MOUNTING & WIRING

Figure 13

Flow K Factors

Refer to manufacturers documentation for proper K-factors.

Flow Setpoints

*** REMEMBER TO MOVE JUMPER J5 TO "OFF" IF CHANGING A SETPOINT ***
AND MOVE BACK TO THE ON POSITION WHEN COMPLETE.

SETPOINT	DESCRIPTION	RANGE	DEFAULT
36	Meter 1 Factor - This setpoint is used to calibrate the permeate flow meter.	0001.00-9999.99	000000
37	Meter 2 Factor - This setpoint is used to calibrate the concentrate flow meter.	0001.00-9999.99	000000
38	Meter 3 Factor - This setpoint is used to calibrate the recirculate flow meter.	0001.00-9999.99	000000
39	Low Permeate Flow - If the permeate flow drops below this value, a low permeate flow alarm will be displayed. If set to 0000, this alarm is disabled.	001.0-999.9 GPM/LPM	0000
40	High Permeate Flow - If the permeate flow rises above this value, a high permeate flow alarm will be displayed. If set to 0000, this alarm is disabled.	001.0-999.9 GPM/LPM	0000
41	Low Concentrate Flow - If the concentrate flow drops below this value, a low concentrate flow alarm will be displayed. If set to 0000, this alarm is disabled.	001.0-999.9 GPM/LPM	0000
42	High Concentrate Flow - If the concentrate flow rises above this value, a high concentrate flow alarm will be displayed. If set to 0000, this alarm is disabled.	001.0-999.9 GPM/LPM	0000
43	Flow Totalizer - The permeate flow totalizer can be reset to 0 by programming this setpoint to 000000. The number shown when this setpoint is displayed may not match the current total. This is normal as this setpoint is only used to clear the total.	000000 GAL/LTR	

Flow Operation

Dipswitch 6 (see Figure 3) must be ON for the flow metering screen to be displayed. The flow rate display is shown by pressing the display key on the keyboard until the flow display is reached. Permeate, concentrate, and recirculate flows are displayed. If a sensor is not installed for one of the flow rates, that display will read 0.0. If the permeate flow sensor is installed, the total permeate flow per day and the current permeate total will be shown in addition to the permeate flow per minute. If the permeate and concentrate sensors are both installed, the system feed flow rate and also the system percent recovery are calculated and displayed. Press the display key to return to the main display.

Flow Alarms

Low and high flow rate alarms are available for the permeate and concentrate flows. When the setpoints for these alarms are programmed to a value other than 0, the alarm lamp will light and the active alarm is shown on the alarm screen when the setpoint is exceeded.

pH MONITORING

The optional pH monitoring allows the ROTrol II to monitor feed water pH. Setpoints are provided to allow warnings or shutdowns for high and low pH conditions.

The pH interface board is mounted to the main board in the upper left corner of the board (see Figure 15) or to the optional flow meter interface board. The pH and/or flow interface boards may be removed to allow easier wiring of the analog sensors to their terminal strip. To remove the pH board, remove the 2 screws holding the board and lift straight up on the board to unplug it from the connector. If the optional flow meter interface board is installed, remove the spacer and 2 screws holding the flow board in place and lift it from the connector. After the analog sensors have been wired, install the flow meter interface board if used, and wire any flow sensors. Install the pH board and wire the pH sensor to the terminal strip.

pH Sensor Mounting

****** WARNING - THE END OF THE pH SENSOR MUST BE WET AT ALL TIMES - i.e. KEEP THE CAP ON THE SENSOR AND DO NOT INSTALL IN THE FLOW LINE UNTIL THE UNIT IS ACTUALLY PLACED INTO SERVICE. *******

The pH sensor must be mounted in the flow line and oriented to allow physical contact with the fluid being measured and not allow air to be trapped around the sensor i.e. the pH sensor should be side or bottom mounted in horizontal pipe runs. Also, the output from the pH sensor is a low level voltage which may be affected by any static charges and/or stray currents flowing in the fluid stream. It is recommended that the pH sensor be installed in a grounded metal fitting to prevent possible stray voltages from affecting the reading. See Figure 15 for one suggested mounting configuration.

pH Sensor Wiring

Connect the shield wire to TB1 - and the signal wire or center conductor to TB1 +. The shorting jumper must be removed from J10 on the main PC board to enable pH readings. Refer to Figure 16 for pH wiring information and Figure 3 for J10 location.

pH Calibration

The pH sensor is calibrated at the factory, but periodic recalibration should be done to maintain sensor accuracy. Refer to Figure 16 for adjustment locations. To calibrate the pH monitor, insert the pH sensor in a pH 4.0 standard solution and adjust the zero control for a reading of 4.0. Remove the pH sensor, rinse with distilled water, and shake dry. Then insert the probe in a pH 10.0 standard solution and adjust the span control for a reading of 10.0. These steps should be repeated several times as there is some interaction between the 2 adjustment controls. Also, most pH sensors respond to changes very slowly - allow adequate time for the reading to stabilize each time the sensor is moved into a different solution before making any adjustments.

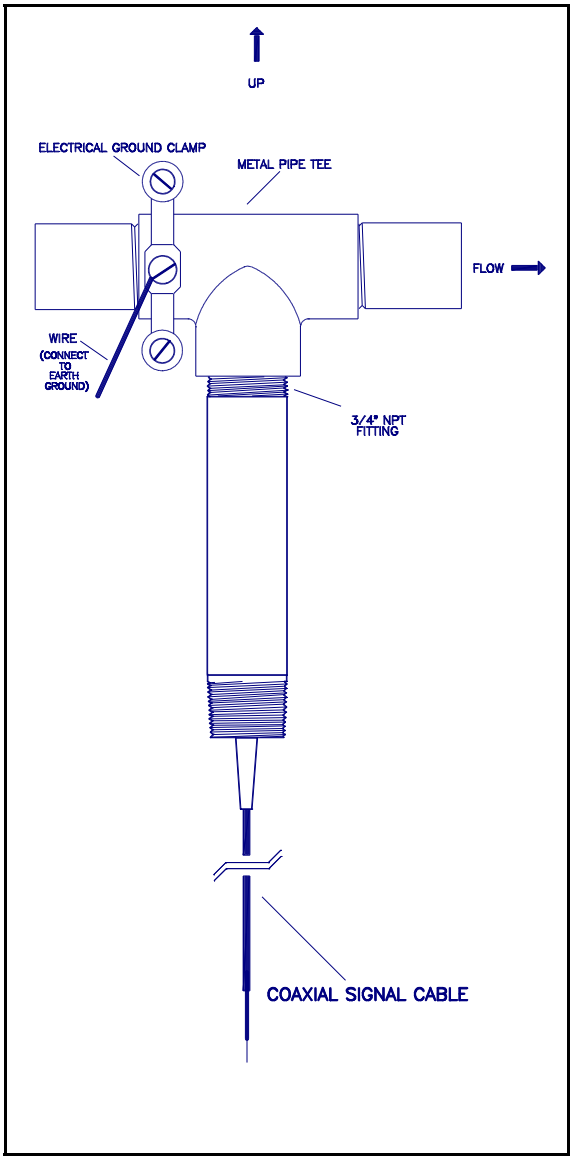


Figure 15

pH Setpoints

*** REMEMBER TO CHANGE JUMPER J5 TO "OFF" IF CHANGING A SETPOINT AND MOVE J5 BACK TO THE ON POSITION WHEN COMPLETE. ***

SETPOINT	DESCRIPTION	RANGE	DEFAULT
45	LOW pH ALARM - If the pH reading drops to or below this value, a low pH alarm will be displayed. Set to 000 to disable alarm.	01.0-13.0	06.0
46	HI pH ALARM - If the pH reading rises to or above this value, a high pH alarm will be displayed. Set to 000 to disable alarm.	01.0-13.0	08.0

SETPOINT	DESCRIPTION	RANGE	DEFAULT
47	LOW pH SHUTDOWN - If the pH reading drops to or below this value, a low pH shutdown will occur after the pH delay has timed out. Set to 000 to disable shutdown.	01.0-13.0	05.0
48	HIGH pH SHUTDOWN - If the pH reading rises to or above this value, high pH shutdown will occur after the pH delay has timed out. Set to 000 to disable shutdown.	01.0-13.0	10.0
49	pH DELAY - This is the time the pH value must meet the shutdown setpoint before a pH shutdown will occur.	00-99 seconds	10

pH Operation

The pH is displayed by pushing the display key until the screen 2 is shown. Pushing the display key again will advance the display to the next screen.

If the pH value has reached one of the warning levels, the alarm light will light and low or high pH will be shown on the alarm display. If the pH value reaches one of the shutdown levels and is maintained for the time programmed in setpoint 49 (pH Delay), the ROTrol II will shutdown the RO pump, flash the alarm lamp, and sound the audible alarm. The display will show the pH shutdown message on the display. The unit will remain shutdown until the reset key is pressed.

NOTE: pH electrodes age with time and eventually become desensitized and must be replaced. The actual service life of a pH electrode is extremely variable and is dependant on many factors. Exposure to extremely pure water will accelerate electrode aging and cause a shorter service life.

pH Electrode Warranty

The manufacturer warrants that at the time of shipment, the pH electrode shall be free from defects in material and workmanship and shall perform within stated specifications upon initial installation.

If the electrode proves to be defective within the above warranty, the manufacturer will replace the electrode with a similar model or product.

ORP Monitoring

The optional ORP monitoring allows the ROTrol II to monitor feed water ORP. The range of ORP monitored is from 0-750mV. Setpoints are provided to allow warnings or shutdowns for a high ORP condition.

The ORP sensor is mounted and wired in a similar fashion to a pH sensor. Refer to the pH section for these instructions.

ORP Setpoints

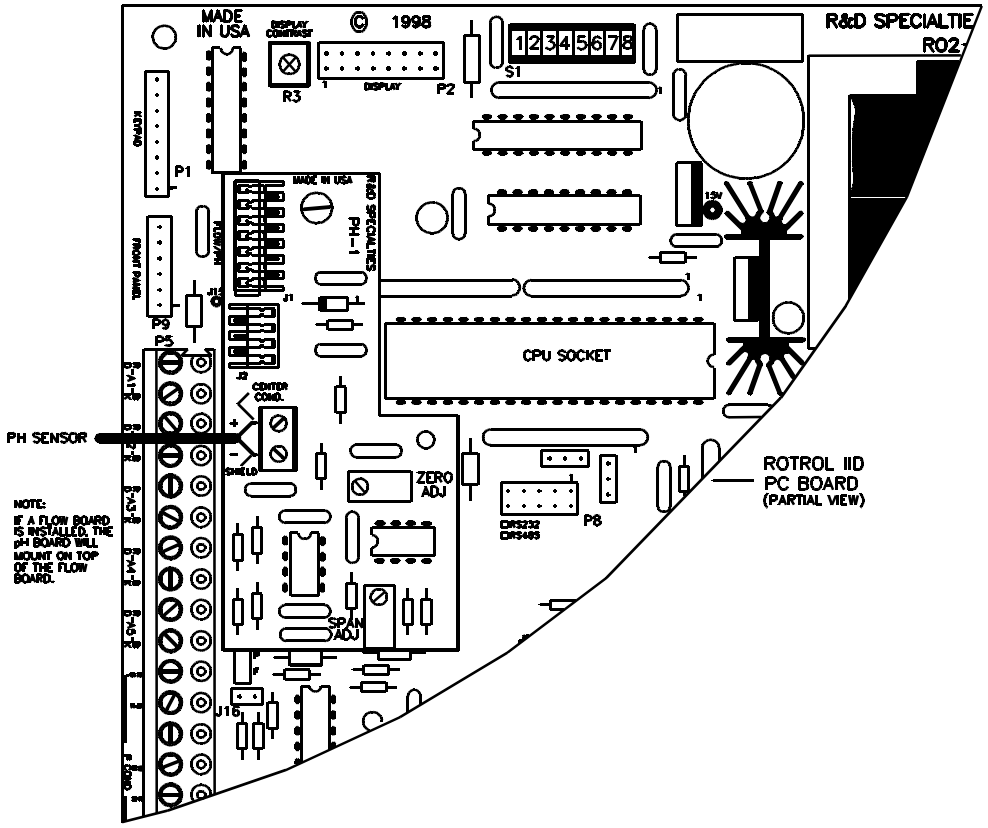
*** REMEMBER TO CHANGE JUMPER J5 TO "OFF" IF CHANGING A SETPOINT AND MOVE J5 BACK TO THE ON POSITION WHEN COMPLETE. ***

SETPOINT	DESCRIPTION	RANGE	DEFAULT
58	pH/ORP - Selects pH(0) or ORP(1) operation.	0-1	0
59	ORP LIMIT - If the ORP reading rises to or above this value, a high ORP alarm will be displayed. Set to 000 to disable alarm.	000-750 mV	000
60	ORP SHUTDOWN - If the ORP reading rises to or above this value, a high ORP shutdown will occur after the ORP delay has timed out. Set to 000 to disable the shutdown.	000-750 mV	000
61	ORP DELAY - This is the time the ORP value must meet the shutdown setpoint before a ORP shutdown will occur.	00-99 seconds	10

ORP Operation

The ORP is displayed by pushing the display key until the screen 2 is shown. Pushing the display key again will advance the display to the next screen.

If the ORP value has reached one of the warning levels, the alarm light will light and high ORP will be shown on the alarm display. If the ORP value reaches one of the shutdown levels and is maintained for the time programmed in setpoint 61 (ORP Delay), the ROTrol II will shutdown the RO pump, flash the alarm lamp, and sound the audible alarm. The display will show the ORP shutdown message on the display. The unit will remain shutdown until the reset key is pressed.



CABLE PREPARATION

1. USING A SHARP KNIFE, CAREFULLY REMOVE APPROXIMATELY 1 1/2" OF THE OUTER JACKET.
2. CAREFULLY UNWEAVE APPROX 1 1/4" OF THE WIRE BRAID AND TWIST TIGHTLY AS SHOWN.
3. USING A SHARP KNIFE, VERY CAREFULLY REMOVE APPROX 1" OF THE BLACK INNER JACKET.
4. USING A SHARP KNIFE, CAREFULLY REMOVE APPROX 1/4" OF THE CLEAR JACKET.
5. CLEAN THE CLEAR JACKET WITH ALCOHOL OR VERY CLEAN WATER AND DRY THOROUGHLY. (THE BLACK JACKET IS IMPREGNATED WITH GRAPHITE WHICH WILL AFFECT THE READING IF ANY PARTICLES CONTAMINATE THE SURFACE OF THE CLEAR JACKET.
6. CONNECT THE CENTER CONDUCTOR AND SHIELD TO THE TERMINAL STRIP ON THE pH BOARD AS SHOWN ABOVE.

pH BOARD MOUNTING & WIRING

Figure 15

ALARM/DIVERT RELAY BOARD

An optional PC board is available to provide relay outputs for operating additional devices or equipment when alarms are detected by the ROTrol II or the TDS/Conductivity Setpoint is exceeded.

The optional relay board attaches to the ROTrol II terminal strip P4 as shown in Figure 17. The relay outputs do not supply power but will switch power routed through them to the controlled devices (1 phase). Each relay is capable of switching loads up to 5A at voltages up to 240V.

The alarm output activates whenever any warning or shutdown is active. The divert output can be used to operate a divert valve or can be used as a high TDS/Conductivity alarm output. The divert output is active any time the TDS/Conductivity is above the value programmed in Setpoint 10.

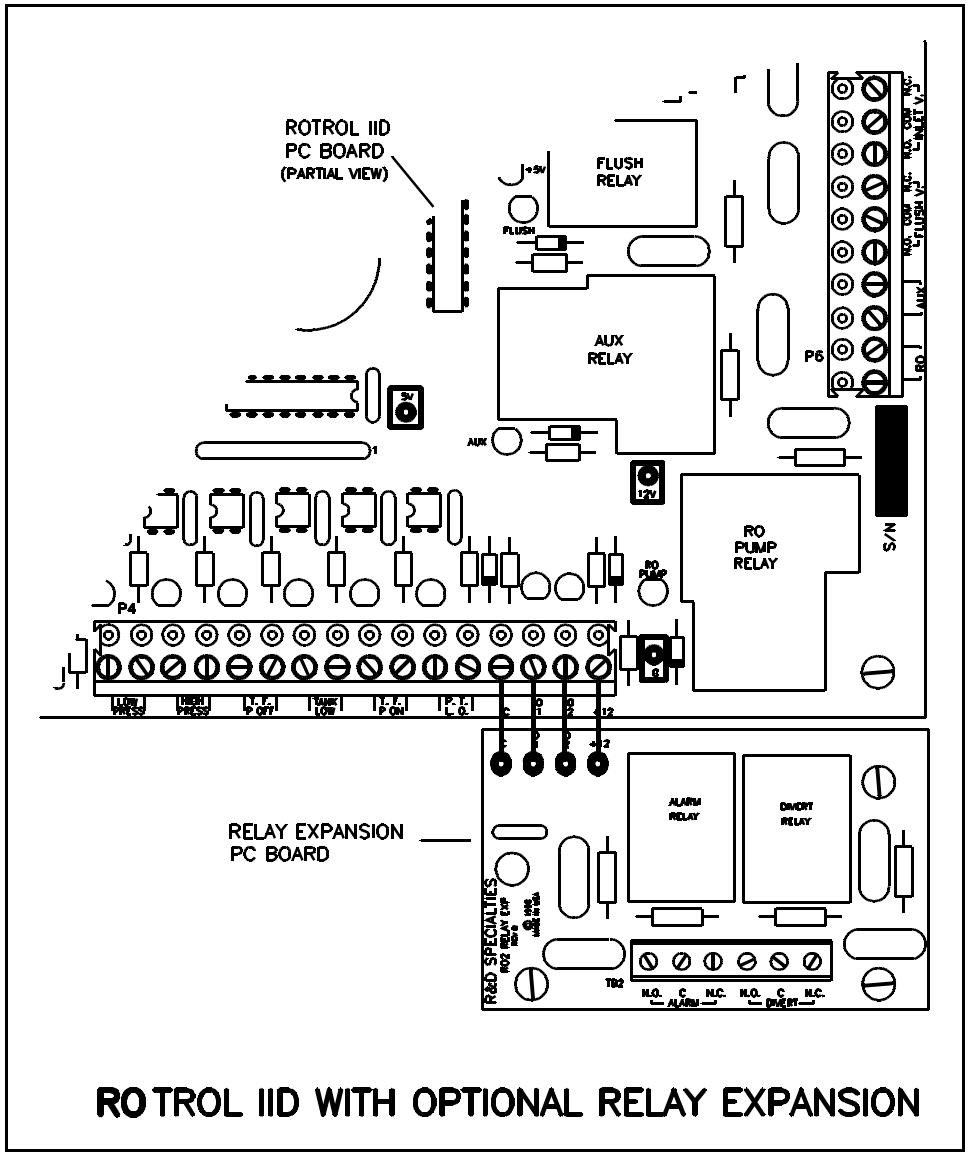


Figure 17

TROUBLESHOOTING

CAUTION: Hazardous voltages are present when power is applied to the unit. Care should be taken when troubleshooting any of the input power or relay output circuits. When disconnecting or connecting any board or accessory, be sure power to the unit has been turned off.

Before replacing any PC boards and accessories or making any adjustments to the unit, please refer to the appropriate troubleshooting section for the proper testing methods. Incorrect adjustments can mask problems or can cause further problems. Check all setpoints and verify proper values for each setpoint. In the event you are unable to determine the cause of a failure, you can contact R & D Specialties for further assistance. Please make note of the events leading up to the failure, the exact failure, what LED's if any that are on, what readings are shown on the display, etc., before contacting technical support. The more information you have when you contact us, the easier it will be to determine the source of the problem. Technical support can be contacted by Fax at 915 561-5696, by email at trproc@rdspec.com or by phone at 915 561-5707. Phone support is only available from 8AM to 5PM Central Standard Time.

BUILT-IN AIDS

To help in locating any malfunctions, all of the switch inputs have green LED lamps, DS2 through DS7, that indicate when the switch for an input is closed. The relays have red LED lamps, DS11 through DS14, that indicate when a relay is energized. Green LED DS1 indicates that power is applied to the board and amber LED DS8 blinks when the CPU chip is operating properly. Make a note of which lamps are on, what is indicated on the display, and any actions that were performed prior to the problem occurring. This information can be an aid in troubleshooting the unit. Refer to Figure 3 for the location of terminal strips, the fuse, LEDs and adjustments.

TOOLS/TEST EQUIPMENT

Although most problems can be solved using the built-in aids discussed above, some problems can be solved faster using additional test equipment.
A digital voltmeter (DVM), one or more 1500 ohm 1/2 watt resistors, a 10,000 ohm 1/2 watt resistor, and a 33,000 ohm 1/2 watt resistor will greatly enhance your ability to pinpoint some problems quickly. Refer to Figures 18-20 for further troubleshooting procedures.

SPECIFIC PROBLEMS

System Inoperative:
Is the green +5V LED (DS1) lit? Is the amber CPU ACTIVE (DS8) lamp blinking? If no, check the power source (circuit breaker usually). Then check the power wires connected to P3 L1 & L2 either visually or measure between them with a DVM. If they are tight in the terminals or the DVM shows the correct voltage at P3 L1 & L2, check the fuse (next to P3) and the front panel power switch and wiring to P3. If checking visually, look for loose wires, a broken switch, or a blown fuse (located to the left of P3). If using a DVM, measure the voltage between L1 and the top terminal of P3 and between L1 and both ends of the fuse clip. Correct any problem/s found. If no problems are found, the PC board is probably defective and should be replaced.

Display Blank:
Turn the power off and back on. If the POWER ON LED DS1 and CPU ACTIVE LED DS8 are not on, see System Inoperative above. If DS1 is on and DS8 is blinking, ensure that the display cable is plugged into the display connector P2 and inspect the ribbon cable solder connections on the display board for broken wires. If the cable appears intact, try adjusting the display contrast control. If none of these checks reveal a problem, the display should be replaced.

RO Pump Will Not Operate:
The RO pump will not operate if the RO pump switch is off, an RO pump restart time delay is active, the tank full input is present, a low or high pressure shutdown has occurred, or the pre-treat lockout signal is present.
First, turn the RO pump switch on, then check to see if the relay LED, DS14, is on. If it is and the pump will not run, check all the wiring from P6 to the RO pump (or motor starter if equipped) and to the power source feeding the motor with a DVM. If voltage is measured between the power wire feeding the motor directly and both RO pump terminals of P6, either the wire from P6 to the motor is broken or loose, or the pump motor is bad. If voltage is present on 1 terminal of P6 (from the power source) but not the other and DS14 is on, the relay is may be bad requiring the circuit board to be replaced. (Reference Figure 4,5 or 6 for correct wiring.)

If DS14 is off and the RO pump switch is on, check the green LEDs above P4 (DS2-7), check the alarm lamp on the front panel, and note all readings on the LCD display. Remember these indicators and LCD readings, and read through the section "SYSTEM OPERATION" in this manual. Using both the knowledge of how the unit operates, and the indications shown by the LEDs and LCD, you should be able to determine whether the problem is on or off the PC board (malfunctioning level switch, pressure switch, etc.). If the unit is not responding correctly to the signals feeding the unit (input switches, etc.), the PC board should be replaced.

Inlet valve will not operate:
The inlet valve will not operate unless the RO PUMP switch is on. Also, there must be no shutdown alarms present, the unit must not be in any restart time delay period, and it must not have a tank full or pre-treat lockout signal present. Check for all normal shutdown conditions by observing the LEDs DS2-DS7, the LCD display, and the position of the RO PUMP switch. If conditions indicate that the inlet valve should be open, LED DS11 should be on. If DS11 does not light, the RO PUMP is operating, and the unit is not engaged in a membrane flush cycle, the PC board should be replaced.

If LED DS11 is on and the valve does not operate, check the wiring between the valve's power source and the valve. If all wiring appears intact and correctly wired (see Figure 4,5 or 6), check for the correct voltage on the valve with a DVM. If voltage is present on the valve, it is probably bad and should be replaced. If voltage is not present on the valve, check between the valve's unswitched (directly wired to valve) power lead the P6 terminals labeled "INLET V.". Between the unswitched wire and the P6 terminal "COM", the supply voltage (120/240) should be present. If the voltage is not correct, the problem is either a break in the wiring between the P6 terminal "COM" and the power source or the power source proper. (It will probably be connected to several other wires with a wire nut or splice of some kind which may be loose.) If the correct voltage is present at P6 "COM", it should also be present at the terminal "N.O." when DS11 is on and at the terminal "N.C." when DS11 is off. If DS11 is on and no voltage is present on "N.O.", the PC board should be replaced.

Aux/RP pump will not operate:
The Aux/RP pump will not operate if the AUX switch (front panel) is off, the Aux Start Time Delay is active, or the Tank Low input is present.

Turn the AUX Switch on, (if off) and check the LED DS13. If DS13 is on, check the pump motor wiring as explained above in the RO pump section. If DS13 does not light, check DS5. If DS5 is on, the Tank Low input is present and the pump should not start. If necessary, correct the Tank Low condition and then re-check the unit for correct operation. If the Tank Low LED (DS5) is off, the AUX Switch is on, and DS13 does not light, check Setpoint 15. If the unit has shut down the AUX output because the Tank Low input had been present, the unit will not restart until the time set into Setpoint 15 has expired. Allow the amount of time selected by Setpoint 15 to elapse and if the AUX output still does not occur, the PC board is bad and should be replaced.

RO unit not flushing or not flushing correctly:
***** NOTICE If your CPU version # ends with "S__" (see Figure 3 for location of CPU), you have a custom chip and should have a manual addendum explaining the correct flush operation if different from the standard variations explained in the section SYSTEM OPERATION. ********

First determine when and exactly what the correct operation should be when flush occurs. The correct operation is explained in the section SYSTEM OPERATION for the different dipswitch settings and related Setpoint values.

If flush has been initiated, DS12 should be on and the flush valve should open. If DS12 is on and the valve does not switch, check the wiring between the valve's power source and the valve. If all wiring appears intact and correctly wired (see Figure 4,5 or 6), check for the correct voltage on the valve with a DVM. If voltage is present on the valve, it is probably bad and should be replaced. If voltage is not present on the valve, check between the valve's unswitched (directly wired to valve) power lead and the P6 terminals labeled "FLUSH V.". Between the unswitched wire and the P6 terminal "COM", the supply voltage (120/240) should be present. If the voltage is not correct, the problem is either a break in the wiring between the P6 terminal "COM" and the power source or the power source proper. (It will probably be connected to several other wires with a wire nut or splice of some kind which may be loose.) If the correct voltage is present at P6 "COM", it should also be present at the terminal "N.O." when DS12 is on and at the terminal "N.C." when DS12 is off. If DS12 is on and no voltage is present on "N.O.", the PC board should be replaced.

Pressure sensor readings incorrect or not reading:
All pressure sensor readings require Dipswitch 1 to be turned ON (up). With Dipswitch 1 ON, each sensor reading may be enabled/disabled with its corresponding jumper J6, J7, J8, or J9 (FEED, PUMP, PREFILTER DIFF., and MEMBRANE DIFF. respectively). A sensor reading is disabled by plugging a shorting block onto both pins. The absence of a shorting block or the shorting block plugged into 1 pin only will enable the reading.

If no pressure readings are present on the LCD display, either Dipswitch 1 is OFF; one or more pressure sensors (or cable) is bad or mis-wired; a TDS/Conductivity sensor is bad; or the PC board is bad. Assuming Dipswitch 1 is ON, the problem may be isolated to a failed sensor or PC board by one of the following methods.

Method 1 - no DVM available
Turn off the Power switch on the front panel and disconnect the red wires for both TDS/Conductivity sensors and every pressure sensor except 1 at the terminal strips P5 and P7. Then place the shorting blocks across both pins of the corresponding enable jumpers J6-J9 for the disconnected sensors (to disable the alarms for those sensors). Turn the Power switch on and check the LCD display for a pressure reading from the sensor still connected to the terminal strip. If a good reading is obtained, that sensor is good. If the reading is bad, either the sensor is bad or the PC board is bad. If the reading is good, leave the good sensor connected. Then, one at a time, connect each disconnected sensor and remove its jumper to enable a reading. If the reading is correct, leave the sensor connected and check the remaining sensors one at a time in the same fashion. If any good readings are obtained, the PC board is probably good and each sensor giving a good reading is OK. Replace any bad sensor encountered. If no good reading is obtained with any sensor, the PC board is probably bad and should be replaced. If all pressure sensors read OK, one or both of the TDS/Conductivity sensors may be bad.

***** A 1500 OHM RESISTOR CONNECTED TO ANY PRESSURE INPUT IN PLACE OF THE SENSOR SHOULD GIVE APPROXIMATELY A MID-SCALE READING EXAMPLE: A 400 PSI SENSOR SHOULD READ APPROXIMATELY 200 PSI *******

Method 2 - DVM available
With power applied and a DVM setting (range) of 20VDC or better, measure the voltage between the bottom and top terminals of P5 (TDS SENSOR -SH and A-1 - RD). If the reading is less than 14VDC, disconnect the red wire of each pressure sensor one at a time while observing the DVM. If the reading jumps to approximately 15VDC after a wire is disconnected, that sensor or its cable is bad. With the bad sensor disconnected, all other pressure readings should read correctly. If all pressure sensors are disconnected and the 15VDC is still not correct, disconnect the red wires on the TDS/Conductivity sensors one at a time and if the 15VDC returns, the sensor disconnected at the time the 15VDC appeared is bad and should be replaced.

If the 15VDC reading is correct with all sensors connected, measure between each pressure sensor's "BK" terminal and the bottom terminal of P5. The valid voltage range is 1-5VDC for these readings. If any sensor (black wire) is outside this range, it is probably bad. If the reading is extremely high (7VDC or better) it may over drive the analog circuitry on the PC board and cause all readings to be bad. Disconnect any bad sensor(s) and the other sensors should read correctly.

If all readings appear to be wrong, one or more sensors may be bad or mis-wired or the PC board may be bad. Check for bad sensors and wiring errors as explained in the previous section. Also, ensure that each sensor is of the correct range and installed in the correct location.

No TDS/Conductivity or temperature readings:
Check the wiring for each sensor. Also, if the feed sensor is not reading, verify that jumper J12 is removed.

Both TDS/Conductivity sensors have temperature outputs but only one will be monitored and displayed. J13 selects the temperature sensor to be monitored. If the shorting block is plugged into the top 2 pins of J13, it will monitor the PERMEATE temperature sensor output. If it is plugged into the bottom 2 pins, it will monitor the FEED temperature sensor output. If the temperature reading is bad and both sensors are present, moving the shorting block to select the alternate sensor may yield a good reading on the LCD. If so, the sensor originally selected is bad and should be replaced. If neither sensor reads correctly, try removing the red wires from all pressure sensors at terminal strip P5. If neither sensor reads

correctly now, disconnect each TDS sensor's red wire at terminal strip P5 and P7 one at a time. Move J13 to select the connected sensor and check the reading. If the reading is good, that sensor and the PC board are good. Whether the reading was good or bad, disconnect that sensor's black wire, reconnect the second sensor's black wire, move J13's shorting block and check the LCD reading. If at least one sensor gives a good reading, that sensor and the PC board are good. If any pressure sensor(s) was disconnected, reconnect the wire(s) and ensure that the temperature reading remains good. Replace all bad sensors found. If no good reading was obtained, the PC board should be replaced.

**** A 1500 OHM RESISTOR MAY BE CONNECTED IN PLACE OF THE RED AND BLACK WIRES OF THE SELECTED SENSOR TO GIVE APPROXIMATELY A 75 °F READING AND THE 10000 AND 33000 OHM RESISTORS CAN BE CONNECTED IN PLACE OF THE WHITE AND GREEN WIRES TO GIVE TDS/CONDUCTIVITY READINGS ****

TDS/Conductivity sensor reading(s) inaccurate:
Verify that each sensor is wired correctly and the temperature reading is correct. The sensor readings are temperature compensated and if the temperature reading is not correct, the TDS/Conductivity readings will not be correct. Also, each sensor must have a good fluid flow around the sensing element (pins) to yield an accurate reading. (See Figure 7 for correct sensor installation.)

If the temperature reading is good, the sensors are installed correctly, any/all pressure readings are correct, and the readings are simply off, the sensors' probe pins may need to be cleaned. It may also be necessary to re-calibrate the unit as explained in the ADJUSTMENTS section.

Keypad problems:
Ensure that the keypad ribbon cable is plugged into the PC board. Then press a key and if no beep is heard and nothing changes on the LCD display, the keypad is probably bad and should be replaced.

If a wrong indication on the LCD display or a long beep is heard when pressing most keys, press "3" on the keypad. If "setpoint:" shows on the display, turn the Power switch off, unplug the ribbon cable from the keypad connector P1, rotate it 180 degrees, and plug it back in. Turn the power on and re-check the keypad. If the keypad still malfunctions, either the keypad or the PC board or both should be replaced.

Flow screen is not displayed:
Dipswitch 6 must be ON to enable flow metering.

No reading from any flow sensor:
Check all flow sensor wiring and verify that the jumpers on the flow interface board are in the correct positions for the sensors installed (see Figure 13). If all is correct, the flow interface is probably bad and should be replaced.

No reading from one flow sensor:
If the pulses are being received from a flow sensor, the corresponding red LED on the flow board should be blinking. Exchange wiring with a sensor that is working (change jumper position if necessary). If the LED now blinks and a reading is now shown, replace the bad sensor. If a reading is not shown, replace the flow interface board.

Flow sensor readings inaccurate:
The meter factor for each sensor installed may need to be adjusted. If the reading is higher than the actual flow, increase the meter factor. If the reading is lower, decrease the meter factor (see Figure 14). Also, verify that each sensor

is installed in the proper location and wired to the correct terminal strip.

pH sensor not reading or inaccurate:
Slow response or large errors can be caused by coated or dirty electrodes. If the electrode is coated with a soft substance, the electrode may be cleaned by rinsing under running water. If this is not successful, try wiping with a soft, wet cloth. For hard coatings such as scale, soaking the electrode in a 5% solution of HCl may work. For some hard coatings, alternate between a 5% HCl solution and a 10% NaOH solution for 10 minutes each. Greasy or oily coatings can be removed by using a detergent solution or isopropyl alcohol. After treating the electrode with these solutions, be sure to rinse well with clean water.

If the LCD display shows no reading for pH, ensure that the shorting block on J10 is off or on only 1 pin. Also check the pH sensor wiring as shown in figure 16. If these checks do not reveal the problem, either the pH sensor or the pH PC board may be defective. Inspect the pH sensor and ensure that it still has fluid inside the glass bulb. If the bulb is dry, either re-fill the sensor with fluid (if re-fillable) or replace it. If the sensor bulb appears to have fluid inside, and the wiring appears intact,
try adjusting the "ZERO ADJ" (Figure 16) adjustment screw to see if any reading appears on the LCD display. If after turning the adjustment screw several turns from its original position (both directions) no reading appears, the pH board should be replaced.

If there is some reading on the LCD display but it is incorrect and does not change with a known change in the pH of the solution surrounding the sensor, the pH sensor is probably bad. Inspect it and its wiring as explained above and correct any problems found or replace it. If the sensor is repaired or replaced and the reading does not change, the pH board should be replaced.

If the LCD reading appears incorrect but changes as the pH of the measured solution changes, it may be necessary to calibrate the pH board. Refer to the pH section for calibration instructions.

Erratic readings can be caused by electrical currents in the fluid stream. If the pH electrode is removed from the piping, calibrates correctly and the reading is stable until the electrode is installed into the piping, this could be the problem. The electrode should be installed in a metal tee that is grounded to a good earth ground. See recommended installation shown in Figure 15.

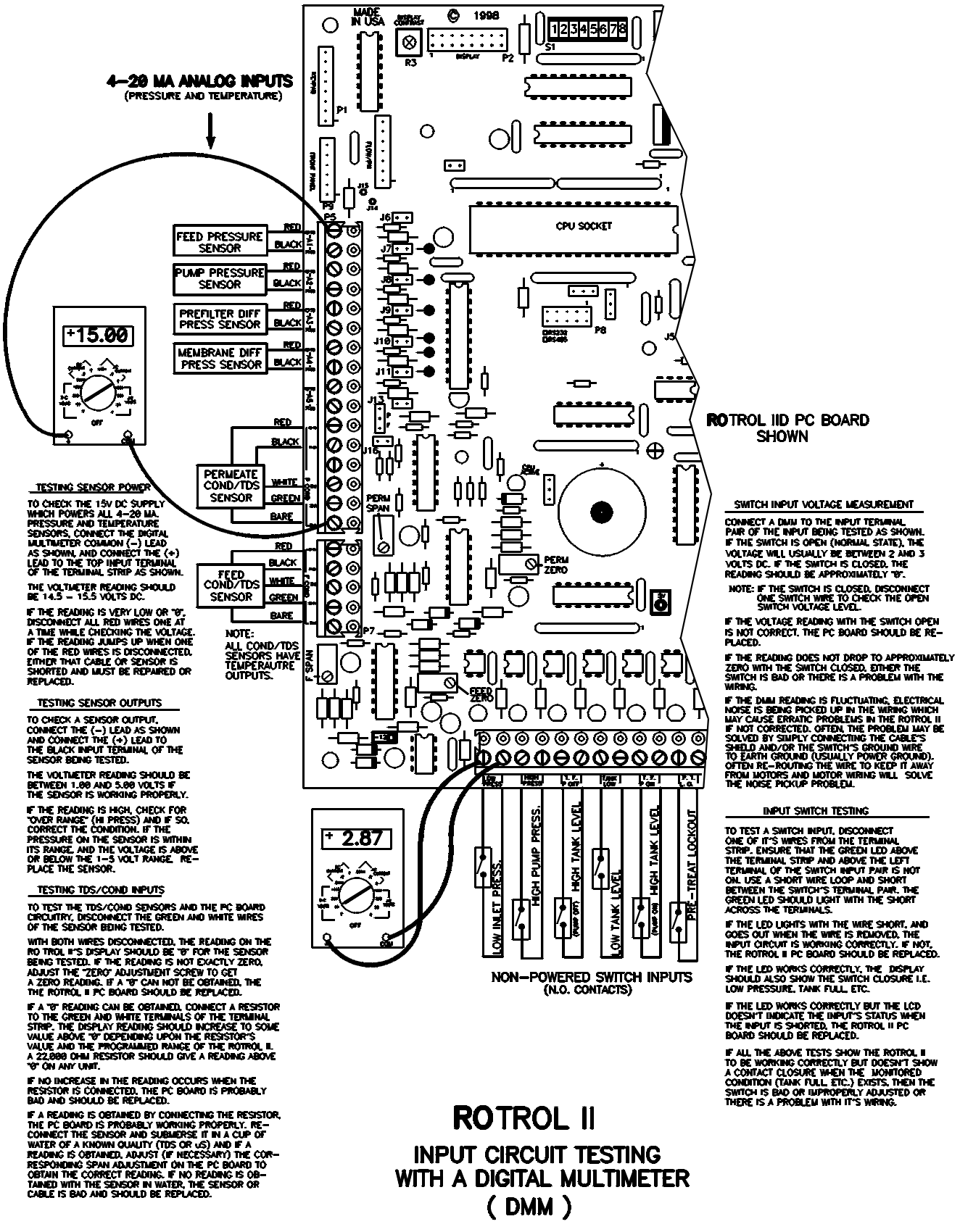

4–20 MA ANALOG INPUTS
(PRESSURE AND TEMPERATURE)
MADE IN USA
© 1998
FEED PRESSURE SENSOR
PUMP PRESSURE SENSOR
PREFILTER DIFF PRESS SENSOR
MEMBRANE DIFF PRESS SENSOR
PERMEATE COND/TDS SENSOR
FEED COND/TDS SENSOR
RED
BLACK
WHITE
GREEN
BARE
+15.00
+ 2.87
CPU SOCKET
ROTROL IID PC BOARD SHOWN
TESTING SENSOR POWER
TO CHECK THE 15V DC SUPPLY WHICH POWERS ALL 4–20 MA. PRESSURE AND TEMPERATURE SENSORS, CONNECT THE DIGITAL MULTIMETER COMMON (–) LEAD AS SHOWN, AND CONNECT THE (+) LEAD TO THE TOP INPUT TERMINAL OF THE TERMINAL STRIP AS SHOWN.
THE VOLTMETER READING SHOULD BE 14.5 – 15.5 VOLTS DC.
IF THE READING IS VERY LOW OR "0", DISCONNECT ALL RED WIRES ONE AT A TIME WHILE CHECKING THE VOLTAGE. IF THE READING JUMPS UP WHEN ONE OF THE RED WIRES IS DISCONNECTED, EITHER THAT CABLE OR SENSOR IS SHORTED AND MUST BE REPAIRED OR REPLACED.
TESTING SENSOR OUTPUTS
TO CHECK A SENSOR OUTPUT, CONNECT THE (–) LEAD AS SHOWN AND CONNECT THE (+) LEAD TO THE BLACK INPUT TERMINAL OF THE SENSOR BEING TESTED.
THE VOLTMETER READING SHOULD BE BETWEEN 1.00 AND 5.00 VOLTS IF THE SENSOR IS WORKING PROPERLY.
IF THE READING IS HIGH, CHECK FOR "OVER RANGE" (HI PRESS) AND IF SO, CORRECT THE CONDITION. IF THE PRESSURE ON THE SENSOR IS WITHIN ITS RANGE, AND THE VOLTAGE IS ABOVE OR BELOW THE 1–5 VOLT RANGE, RE–PLACE THE SENSOR.
TESTING TDS/COND INPUTS
TO TEST THE TDS/COND SENSORS AND THE PC BOARD CIRCUITRY, DISCONNECT THE GREEN AND WHITE WIRES OF THE SENSOR BEING TESTED.
WITH BOTH WIRES DISCONNECTED, THE READING ON THE RO TROL II'S DISPLAY SHOULD BE "0" FOR THE SENSOR BEING TESTED. IF THE READING IS NOT EXACTLY ZERO, ADJUST THE "ZERO" ADJUSTMENT SCREW TO GET A ZERO READING. IF A "0" CAN NOT BE OBTAINED, THE THE ROTROL II PC BOARD SHOULD BE REPLACED.
IF A "0" READING CAN BE OBTAINED, CONNECT A RESISTOR TO THE GREEN AND WHITE TERMINALS OF THE TERMINAL STRIP. THE DISPLAY READING SHOULD INCREASE TO SOME VALUE ABOVE "0" DEPENDING UPON THE RESISTOR'S VALUE AND THE PROGRAMMED RANGE OF THE ROTROL II. A 22,000 OHM RESISTOR SHOULD GIVE A READING ABOVE "0" ON ANY UNIT.
IF NO INCREASE IN THE READING OCCURS WHEN THE RESISTOR IS CONNECTED, THE PC BOARD IS PROBABLY BAD AND SHOULD BE REPLACED.
IF A READING IS OBTAINED BY CONNECTING THE RESISTOR, THE PC BOARD IS PROBABLY WORKING PROPERLY. RE–CONNECT THE SENSOR AND SUBMERSE IT IN A CUP OF WATER OF A KNOWN QUALITY (TDS OR uS) AND IF A READING IS OBTAINED, ADJUST (IF NECESSARY) THE COR–RESPONDING SPAN ADJUSTMENT ON THE PC BOARD TO OBTAIN THE CORRECT READING. IF NO READING IS OB–TAINED WITH THE SENSOR IN WATER, THE SENSOR OR CABLE IS BAD AND SHOULD BE REPLACED.
NOTE: ALL COND/TDS SENSORS HAVE TEMPERAUTRE OUTPUTS.
SWITCH INPUT VOLTAGE MEASUREMENT
CONNECT A DMM TO THE INPUT TERMINAL PAIR OF THE INPUT BEING TESTED AS SHOWN. IF THE SWITCH IS OPEN (NORMAL STATE), THE VOLTAGE WILL USUALLY BE BETWEEN 2 AND 3 VOLTS DC. IF THE SWITCH IS CLOSED, THE READING SHOULD BE APPROXIMATELY "0".
NOTE: IF THE SWITCH IS CLOSED, DISCONNECT ONE SWITCH WIRE TO CHECK THE OPEN SWITCH VOLTAGE LEVEL.
IF THE VOLTAGE READING WITH THE SWITCH OPEN IS NOT CORRECT, THE PC BOARD SHOULD BE RE–PLACED.
IF THE READING DOES NOT DROP TO APPROXIMATELY ZERO WITH THE SWITCH CLOSED, EITHER THE SWITCH IS BAD OR THERE IS A PROBLEM WITH THE WIRING.
IF THE DMM READING IS FLUCTUATING, ELECTRICAL NOISE IS BEING PICKED UP IN THE WIRING WHICH MAY CAUSE ERRATIC PROBLEMS IN THE ROTROL II IF NOT CORRECTED. OFTEN, THE PROBLEM MAY BE SOLVED BY SIMPLY CONNECTING THE CABLE'S SHIELD AND/OR THE SWITCH'S GROUND WIRE TO EARTH GROUND (USUALLY POWER GROUND). OFTEN RE–ROUTING THE WIRE TO KEEP IT AWAY FROM MOTORS AND MOTOR WIRING WILL SOLVE THE NOISE PICKUP PROBLEM.
INPUT SWITCH TESTING
TO TEST A SWITCH INPUT, DISCONNECT ONE OF IT'S WIRES FROM THE TERMINAL STRIP. ENSURE THAT THE GREEN LED ABOVE THE TERMINAL STRIP AND ABOVE THE LEFT TERMINAL OF THE SWITCH INPUT PAIR IS NOT ON. USE A SHORT WIRE LOOP AND SHORT BETWEEN THE SWITCH'S TERMINAL PAIR. THE GREEN LED SHOULD LIGHT WITH THE SHORT ACROSS THE TERMINALS.
IF THE LED LIGHTS WITH THE WIRE SHORT, AND GOES OUT WHEN THE WIRE IS REMOVED, THE INPUT CIRCUIT IS WORKING CORRECTLY. IF NOT, THE ROTROL II PC BOARD SHOULD BE REPLACED.
IF THE LED WORKS CORRECTLY, THE DISPLAY SHOULD ALSO SHOW THE SWITCH CLOSURE I.E. LOW PRESSURE, TANK FULL, ETC.
IF THE LED WORKS CORRECTLY BUT THE LCD DOESN'T INDICATE THE INPUT'S STATUS WHEN THE INPUT IS SHORTED, THE ROTROL II PC BOARD SHOULD BE REPLACED.
IF ALL THE ABOVE TESTS SHOW THE ROTROL II TO BE WORKING CORRECTLY BUT DOESN'T SHOW A CONTACT CLOSURE WHEN THE MONITORED CONDITION (TANK FULL, ETC.) EXISTS, THEN THE SWITCH IS BAD OR IMPROPERLY ADJUSTED OR THERE IS A PROBLEM WITH IT'S WIRING.
NON–POWERED SWITCH INPUTS
(N.O. CONTACTS)
LOW INLET PRESS.
HIGH PUMP PRESS.
HIGH TANK LEVEL
LOW TANK LEVEL
HIGH TANK LEVEL
PRE–TREAT LOCKOUT
ROTROL II
INPUT CIRCUIT TESTING
WITH A DIGITAL MULTIMETER
(DMM)

Figure 17

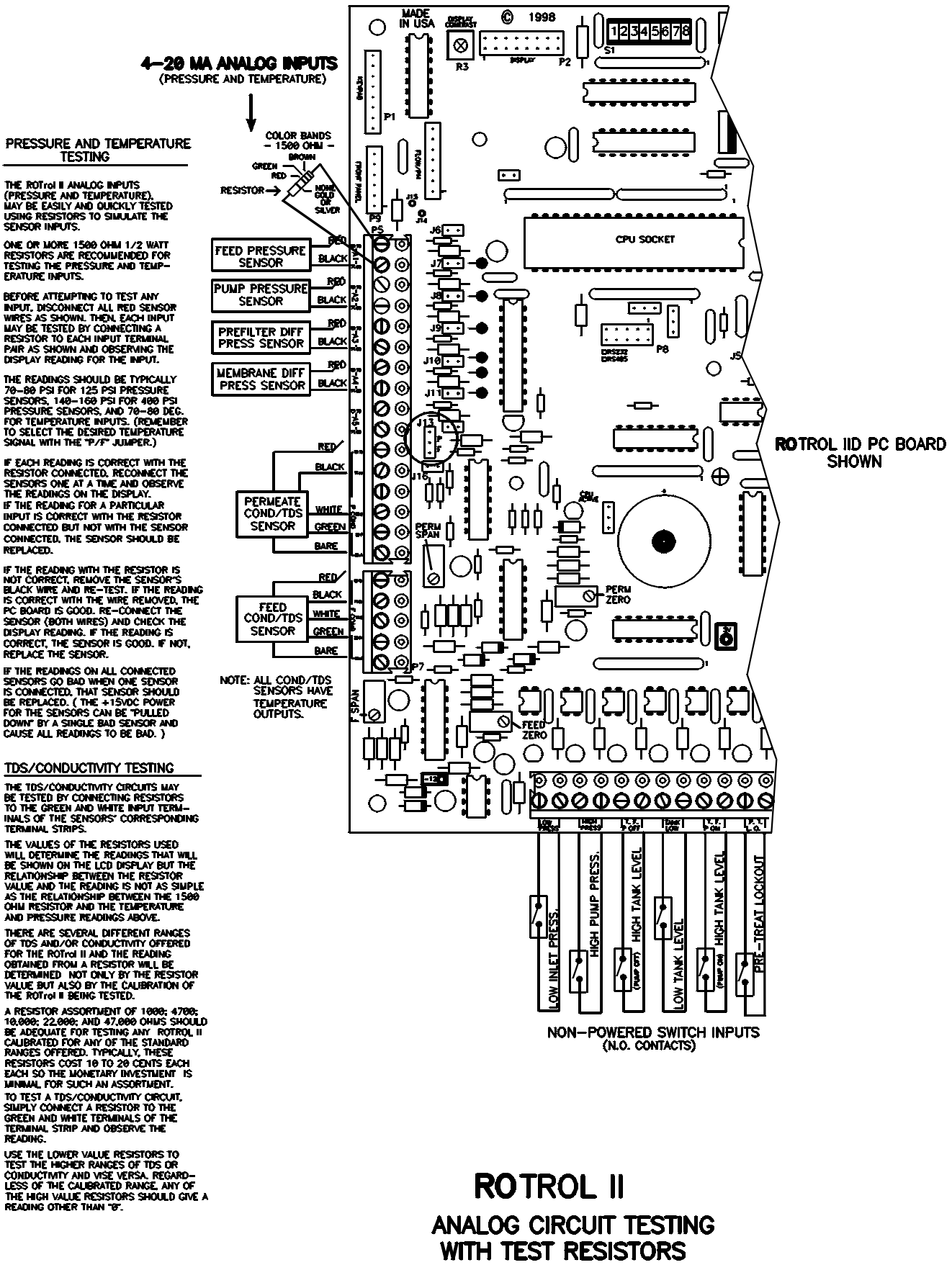
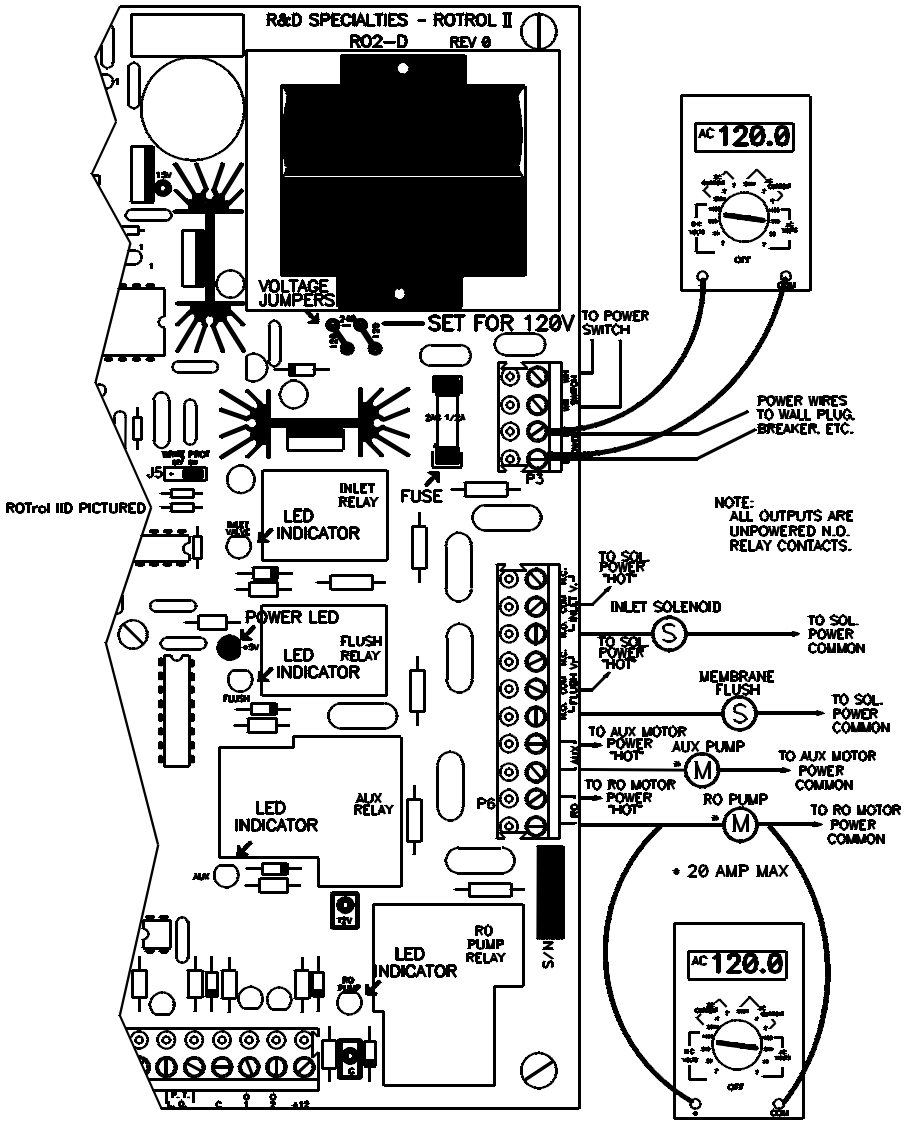

4–20 MA ANALOG INPUTS
(PRESSURE AND TEMPERATURE)
PRESSURE AND TEMPERATURE TESTING
THE ROTrol II ANALOG INPUTS (PRESSURE AND TEMPERATURE), MAY BE EASILY AND QUICKLY TESTED USING RESISTORS TO SIMULATE THE SENSOR INPUTS.
ONE OR MORE 1500 OHM 1/2 WATT RESISTORS ARE RECOMMENDED FOR TESTING THE PRESSURE AND TEMP-ERATURE INPUTS.
BEFORE ATTEMPTING TO TEST ANY INPUT, DISCONNECT ALL RED SENSOR WIRES AS SHOWN. THEN, EACH INPUT MAY BE TESTED BY CONNECTING A RESISTOR TO EACH INPUT TERMINAL PAIR AS SHOWN AND OBSERVING THE DISPLAY READING FOR THE INPUT.
THE READINGS SHOULD BE TYPICALLY 70–80 PSI FOR 125 PSI PRESSURE SENSORS, 140–160 PSI FOR 400 PSI PRESSURE SENSORS, AND 70–80 DEG. FOR TEMPERATURE INPUTS. (REMEMBER TO SELECT THE DESIRED TEMPERATURE SIGNAL WITH THE "P/F" JUMPER.)
IF EACH READING IS CORRECT WITH THE RESISTOR CONNECTED, RECONNECT THE SENSORS ONE AT A TIME AND OBSERVE THE READINGS ON THE DISPLAY. IF THE READING FOR A PARTICULAR INPUT IS CORRECT WITH THE RESISTOR CONNECTED BUT NOT WITH THE SENSOR CONNECTED, THE SENSOR SHOULD BE REPLACED.
IF THE READING WITH THE RESISTOR IS NOT CORRECT, REMOVE THE SENSOR'S BLACK WIRE AND RE-TEST. IF THE READING IS CORRECT WITH THE WIRE REMOVED, THE PC BOARD IS GOOD. RE-CONNECT THE SENSOR (BOTH WIRES) AND CHECK THE DISPLAY READING. IF THE READING IS CORRECT, THE SENSOR IS GOOD. IF NOT, REPLACE THE SENSOR.
IF THE READINGS ON ALL CONNECTED SENSORS GO BAD WHEN ONE SENSOR IS CONNECTED, THAT SENSOR SHOULD BE REPLACED. (THE +15VDC POWER FOR THE SENSORS CAN BE "PULLED DOWN" BY A SINGLE BAD SENSOR AND CAUSE ALL READINGS TO BE BAD.)
TDS/CONDUCTIVITY TESTING
THE TDS/CONDUCTIVITY CIRCUITS MAY BE TESTED BY CONNECTING RESISTORS TO THE GREEN AND WHITE INPUT TERMI-NALS OF THE SENSORS' CORRESPONDING TERMINAL STRIPS.
THE VALUES OF THE RESISTORS USED WILL DETERMINE THE READINGS THAT WILL BE SHOWN ON THE LCD DISPLAY BUT THE RELATIONSHIP BETWEEN THE RESISTOR VALUE AND THE READING IS NOT AS SIMPLE AS THE RELATIONSHIP BETWEEN THE 1500 OHM RESISTOR AND THE TEMPERATURE AND PRESSURE READINGS ABOVE.
THERE ARE SEVERAL DIFFERENT RANGES OF TDS AND/OR CONDUCTIVITY OFFERED FOR THE ROTrol II AND THE READING OBTAINED FROM A RESISTOR WILL BE DETERMINED NOT ONLY BY THE RESISTOR VALUE BUT ALSO BY THE CALIBRATION OF THE ROTrol II BEING TESTED.
A RESISTOR ASSORTMENT OF 1000; 4700; 10,000; 22,000; AND 47,000 OHMS SHOULD BE ADEQUATE FOR TESTING ANY ROTROL II CALIBRATED FOR ANY OF THE STANDARD RANGES OFFERED. TYPICALLY, THESE RESISTORS COST 10 TO 20 CENTS EACH EACH SO THE MONETARY INVESTMENT IS MINIMAL FOR SUCH AN ASSORTMENT.
TO TEST A TDS/CONDUCTIVITY CIRCUIT, SIMPLY CONNECT A RESISTOR TO THE GREEN AND WHITE TERMINALS OF THE TERMINAL STRIP AND OBSERVE THE READING.
USE THE LOWER VALUE RESISTORS TO TEST THE HIGHER RANGES OF TDS OR CONDUCTIVITY AND VISE VERSA. REGARD-LESS OF THE CALIBRATED RANGE, ANY OF THE HIGH VALUE RESISTORS SHOULD GIVE A READING OTHER THAN "0".
COLOR BANDS – 1500 OHM –
BROWN
GREEN
RED
GOLD OR SILVER
RESISTOR
FEED PRESSURE SENSOR
PUMP PRESSURE SENSOR
PREFILTER DIFF PRESS SENSOR
MEMBRANE DIFF PRESS SENSOR
PERMEATE COND/TDS SENSOR
FEED COND/TDS SENSOR
RED
BLACK
WHITE
GREEN
BARE
NOTE: ALL COND/TDS SENSORS HAVE TEMPERATURE OUTPUTS.
MADE IN USA
© 1998
CPU SOCKET
ROTROL IID PC BOARD SHOWN
PERM SPAN
PERM ZERO
FEED SPAN
FEED ZERO
LOW INLET PRESS.
HIGH PUMP PRESS.
HIGH TANK LEVEL (PUMP OFF)
LOW TANK LEVEL
HIGH TANK LEVEL (PUMP ON)
PRE-TREAT LOCKOUT
NON–POWERED SWITCH INPUTS
(N.O. CONTACTS)
ROTROL II
ANALOG CIRCUIT TESTING
WITH TEST RESISTORS

Figure 18



TROUBLESHOOTING NOISE PROBLEMS

VALVES AND MOTORS ARE ELECTROMAGNETIC DEVICES THAT GENERATE ELECTRICAL NOISE (VOLTAGE SAGS OR SURGES) WHEN THEY OPERATE. THIS ELECTRICAL NOISE CAN CAUSE MOMENTARY MALFUNCTIONS IN ELECTRONICS EQUIPMENT IF THE NOISE FINDS ITS WAY INTO THE ELECTRONICS CIRCUITRY.

IF ELECTRICAL NOISE PROBLEMS ARE ENCOUNTERED, THE ROTrol II MAY MOMENTARILY MALFUNCTION IN A VARIETY OF WAYS.

USUALLY, A MICROPROCESSOR RESET WILL OCCUR WHEN THE NOISE IS ENCOUNTERED. IF THE UNIT IS SHUTTING DOWN A PUMP OR CLOSING A VALVE, IT MAY RESTART THE PUMP OR OPEN THE VALVE SEVERAL TIMES BEFORE FINALLY OPERATING PROPERLY. ALSO, THIS REACTION WILL USUALLY BE VERY ERRATIC OCCURING ONLY OCCASSIONALLY. ALSO, IT MAY OPERATE OTHER DEVICES DURING THIS REACTION.

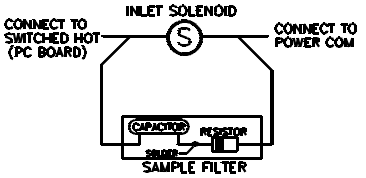
ALTHOUGH CIRCUITS IN THE ROTrol II ARE DESIGNED TO REJECT MOST ELECTRICAL NOISE, DUE TO THE WIRING AND/OR DEVICES OPERATED BY THE ROTrol II, SOME NOISE MIGHT OCCASSIONALLY GET INTO THE CIRCUITRY.

FORTUNATELY, NOISE PROBLEMS CAN USUALLY BE PREVENTED OR SOLVED USING INEXPENSIVE NOISE FILTERS CONNECTED ACROSS THE VALVE OR MOTOR GENERATING THE NOISE.

IT IS ALWAYS ADVISABLE TO EMPLOY NOISE FILTERS WHEN OPERATING ELECTROMAGNETIC DEVICES WITH ELECTRONIC CONTROLLERS. IF R&D SPECIALTIES SUPPLIES THE ROTrol II WITH AN OVERSIZED ENCLOSURE AND WITH PRE-WIRED POWER DISTRIBUTION TERMINAL STRIPS, NOISE FILTERS WILL BE SUPPLIED. IF THE ROTrol II IS SUPPLIED IN ITS GENERIC FORM (STANDARD ENCLOSURE), IT IS THE CUSTOMER'S RESPONSIBILITY TO PROVIDE ALL POWER WIRING, AND ANY NOISE FILTERING.

IT IS ADVISABLE TO INSTALL FILTERS IN ALL CASES SIMPLY TO AVOID POSSIBLE PROBLEMS. FILTERS MAY BE PURCHASED FROM ELECTRONIC SUPPLY HOUSES, OR R&D SPECIALTIES OR CONSTRUCTED FROM COMMONLY AVAILABLE ELECTRONIC PARTS.

A SUGGESTED FILTER IS SHOWN BELOW.



CAPACITOR – .1uF 400V OR HIGHER
RESISTOR – 47 OHM 1/2 WATT

CONNECT FILTER ACROSS DEVICE AS SHOWN

TROUBLESHOOTING POWER PROBLEMS

WARNING! DANGEROUS VOLTAGES PRESENT
PROCEED WITH CAUTION!

WHEN THE CORRECT AC POWER IS APPLIED TO THE ROTrol II, AND THE POWER SWITCH IS SWITCHED ON, THE GREEN POWER LED ON THE ROTrol II PC BOARD SHOULD LIGHT.

IF THE LED DOES NOT LIGHT, VISUALLY CHECK THE VOLTAGE SELECT JUMPERS FOR THE CORRECT SETTING (120V SHOWN IN PICTURE).

IF THE JUMPER SETTING IS CORRECT, MEASURE THE VOLTAGE ON THE POWER TERMINALS WITH A DMM AS SHOWN.

IF THE VOLTAGE IS NOT PRESENT OR CORRECT, ENSURE THAT THE POWER WIRES ARE INTACT BY TRACING THEM BACK TO THE POWER SOURCE (WALL PLUG, BREAKER BOX, ETC) AND ENSURE THAT THE PLUG OR BREAKER IS "HOT". CORRECT ANY PROBLEMS FOUND.

IF THE VOLTAGE READING IS CORRECT ON THE POWER TERMINALS, MEASURE THE VOLTAGE BETWEEN TERMINAL 1 (COM) OF THE TERMINAL STRIP AND TERMINAL 3, TERMINAL 4, AND EACH END OF THE FUSE. IF THE VOLTAGE IS CORRECT ON TERMINAL 3 AND NOT ON TERMINAL 4, EITHER THE POWER SWITCH OR ITS WIRING IS BAD. CORRECT THE PROBLEM BY REPLACING THE SWITCH OR BROKEN WIRE.

IF THE VOLTAGE IS CORRECT ON TERMINAL 4 BUT NOT ON BOTH ENDS OF THE FUSE, REPLACE THE FUSE.

IF THE VOLTAGE IS CORRECT ON BOTH ENDS OF THE FUSE, UNPLUG THE DISPLAY'S RIBBON CABLE. IF THE POWER LED LIGHTS, THE DISPLAY ASSEMBLY SHOULD BE REPLACED. IF THE LED STILL DOES NOT LIGHT, THE PC BOARD SHOULD BE REPLACED.

TROUBLESHOOTING OUTPUT CIRCUITS

WARNING! DANGEROUS VOLTAGES PRESENT
PROCEED WITH CAUTION!

THE OUTPUT CIRCUITRY OF THE ROTrol II IS DESIGNED TO TURN THE OPERATING POWER FOR THE RO UNIT'S VALVES AND MOTORS ON AND OFF. THE ROTrol II DOES NOT SUPPLY POWER IT SIMPLY SWITCHES THE POWER FEEDING EACH OUTPUT CIRCUIT.

EACH OUTPUT CIRCUIT (RELAY CONTACT) IS UNIQUELY INDEPENDENT FROM ALL OTHERS. THIS ALLOWS THE CONTROLLED DEVICES (VALVES, MOTORS, ETC.) TO BE OPERATED AT DIFFERENT VOLTAGES – i.e. THE VALVES MAY BE OPERATED FROM ONE POWER SOURCE, AND THE MOTORS MAY BE OPERATED FROM A DIFFERENT POWER SOURCE. AS AN EXAMPLE, IT IS NOT UNUSUAL TO OPERATE THE VALVES AND AUX (RP) PUMP FROM 120V AND THE RO PUMP FROM 240V.

THIS INDEPENDENT ARRANGEMENT ALLOWS A LOT OF FLEXIBILITY IN SELECTING THE VALVES AND MOTORS FOR AN RO UNIT, BUT IT ALSO COMPLICATES THE TROUBLESHOOTING OF THIS CIRCUITRY AS THE WIRING FOR THESE DEVICES MAY VARY CONSIDERABLY BETWEEN RO UNITS.

THE FIRST STEP IN TROUBLESHOOTING THE OUTPUT CIRCUITRY IS TO DETERMINE EXACTLY HOW THE VALVES, MOTORS, PC BOARD, AND POWER SOURCE(S) ARE WIRED. TURN OFF ALL POWER FEEDING THE RO UNIT AND PHYSICALLY TRACE OUT ALL POWER AND CONTROL WIRING. PAY PARTICULAR ATTENTION TO ANY WIRE NUTS OR OTHER CONNECTORS USED AND ENSURE THAT ALL CONNECTIONS ARE CLEAN AND TIGHT. OFTEN, THE PROBLEMS ARE CORRECTED DURING THIS INSPECTION.

AFTER DETERMINING HOW THE VALVES AND MOTORS ARE WIRED, THE UNIT MAY BE POWERED UP AND TROUBLESHOOTING OF ANY PROBLEMS MAY BEGIN. IT WOULD BE HELPFUL TO READ THE "SYSTEM OPERATION" SECTION OF THE ROTrol II MANUAL (APPROX 3 PAGES) TO ENSURE THAT THE FUNCTIONAL OPERATION OF THE OUTPUT CONTROL CIRCUITRY IS THOROUGHLY UNDERSTOOD i.e. WHEN SHOULD EACH CONTROL RELAY OPERATE AND WHEN SHOULD IT NOT OPERATE.

EACH RELAY WHICH OPERATES A VALVE OR MOTOR HAS A RED LED ON THE PC BOARD THAT LIGHTS WHEN THE RELAY OPERATES. IF A VALVE OR A MOTOR IS NOT TURNING ON, CHECK THE CORRESPONDING LED ON THE PC BOARD TO ENSURE THAT THE RELAY IS OPERATING. IF THE LED IS OFF, CHECK FOR ANY ERROR CONDITIONS (LOW PRESSURE, HIGH PRESSURE, ETC.) OR ANY NORMAL SHUT-DOWN CONDITIONS (PRE-TREAT LOCKOUT, TANK FULL, ETC.) THAT WOULD PREVENT THE RELAY FROM OPERATING. USE THE GREEN INPUT LED INDICATORS AND THE LCD DISPLAY TO DETERMINE THESE CONDITIONS. IF THE RELAY SHOULD BE ON BUT ISN'T, REPLACE THE PC BOARD.

IF A RELAY'S LED IS ON BUT THE CONTROLLED DEVICE (VALVE OR MOTOR) IS NOT OPERATING, MEASURE THE VOLTAGE ACROSS THE DEVICE WITH A DMM. IF THE CORRECT VOLTAGE IS PRESENT, THE DEVICE SHOULD BE REPLACED.

IF THE CORRECT VOLTAGE IS NOT PRESENT, MEASURE BETWEEN THE DEVICE'S POWER COMMON AND THE PC BOARD TERMINAL STRIP. IF THE VOLTAGE IS CORRECT BETWEEN THE "HOT" TERMINAL AND COMMON BUT NOT BETWEEN THE TERMINAL FEEDING THE DEVICE, REPLACE THE PC BOARD. IF THE VOLTAGE IS NOT CORRECT BETWEEN THE "HOT" TERMINAL AND COMMON, TRACE THE "HOT" WIRE BACK TO ITS POWER SOURCE AND CORRECT THE PROBLEM (TRIPPED BREAKER, BLOWN FUSE, OPEN WIRE, ETC.)

ROTrol II

POWER AND OUTPUT TESTING WITH A DIGITAL MULTIMETER (DMM)

Figure 19